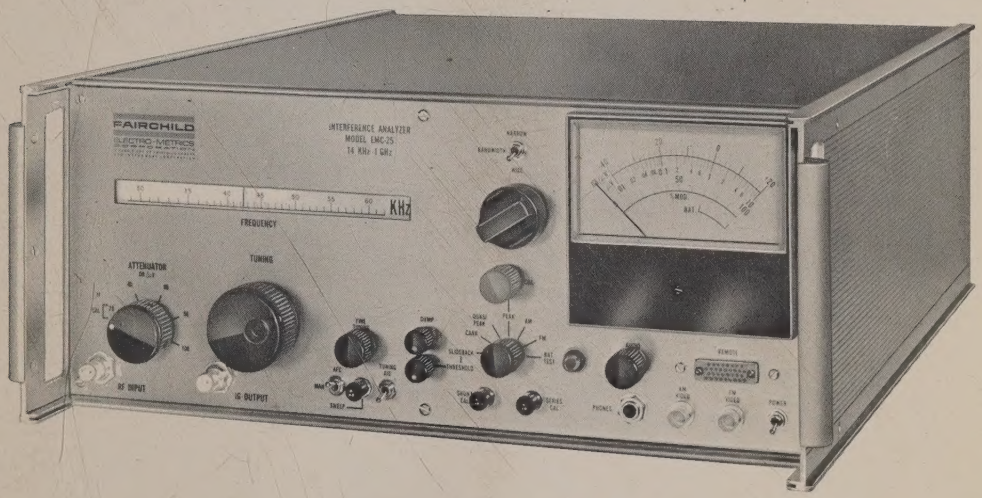
INSTRUCTION MANUAL

ID No. CH 16245
- RETURN TO -
INSTRUMENT CONTROL
SYLVANIA SES -- West

2nd manual.

INTERFERENCE ANALYZER



EMC-25 SERIES

FAIRCHILD
ELECTRO-METRICS
CORPORATION
A SUBSIDIARY OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION
AMSTERDAM, NEW YORK

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Addendum #1

The EMC-25 Series Instruction Manual, as issued May 15, 1967, should be corrected as follows:

page 3-2, Section 3.5.5, 3rd line: "PDC-25 power cord" should read, "PDD-25 power cord".

page 3-5, Section 3.7.3: add Item d), as follows:
"d) For measurement of broadband signals in Band 14 (210-490 MHz), only, always set input ATTENUATOR so as to bring front panel meter reading to "0 dB" or below whenever final input ATTENUATOR setting is "60 dB" or above (orange letters)."

page 3-8, Section 3-14: add new paragraph as follows:
"When measuring or comparing broadband signals, for greatest accuracy always set input ATTENUATOR so that larger signal reads "0 dB" or below on the front panel meter whenever input ATTENUATOR setting is "60 dB" or above (orange letters)."

page 3-10, Sections 3.17.1 and 3.18: change references to "line cord PDA-25" and "PDA-25 line cord" to read, "PCD-25 line cord".

page 3-12, Section 3.21.2: In third line on page 3-12, change "Figure 4.1" to read "Figure 3.8". In Item b), change "paragraph 3.6" to read, "paragraph 3.7".

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SECTION I
INTRODUCTION

1.1 THE MANUAL

This manual includes all relevant information for the successful operation, maintenance and repair of Interference Analyzer EMC-25 or 25R indicated by the serial numbers on the manual's title page. It will be assumed unless specifically noted, that this manual applies to all versions.

1.2 THE EMC-25

Fairchild Electro-Metrics' Interference Analyzer Model EMC-25 has been designed to fill the growing need for instrumentation for RFI/EMC measurements starting with high audio frequencies up to the UHF range.

EMC-25 Interference Analyzer is designed for use as the major component of interference analysis systems for the 14 KHz to 1 GHz range. The instrument itself is a programmable selective RF voltmeter, compatible with a wide variety of peripheral equipment. A selection of antennas enables the measurement of radiated electric and magnetic field intensity, while various output devices simplify data reduction and extend the EMC-25's usefulness as a system component.

It is used as an RFI/EMC meter, a field strength meter, a frequency-selective 2-terminal voltmeter, and other applications requiring a highly sensitive, shielded receiving instrument.

Frequency tuning, band selection (with "R" option), AFC on-off, internal sweep voltage, impulse generator operation and level, bandwidth selection, detector dump operation, and vernier gain can all be externally programmed. Outputs are provided for the pre-IF and post-IF, DC-coupled AM and FM video, audio, voltage analog of frequency, voltage analog of amplitude, binary band indication, center channel tuning indication, and for the impulse generator.

Instructions for operating accessory equipment are supplied with each accessory. Specific applications are discussed in separate application notes. Field intensities are determined by the simple addition of the calibration factors supplied in the instruction manual for the respective antenna being employed.

1.3 ELECTRICAL SPECIFICATIONS

1.3.1 FREQUENCY RANGE. The usable frequency range extends from 14 KHz to 1 GHz in 15 bands.

Each band provides a minimum of 2% overlap at each end with respect to adjacent bands.

1.3.2 FREQUENCY ACCURACY. Frequency accuracy is within plus or minus two percent of indicated frequency. (With FINE TUNE control at mid-rotation.)

1.3.3 INPUT IMPEDANCE. Input impedance is a nominal 50 ohms.

1.3.4 VOLTAGE ACCURACY. Two-terminal CW voltage measurements, referenced against the internal calibrator, are accurate within plus or minus 1.5 DB (top 20 DB of the scale).

1.3.5 SENSITIVITY AND BANDWIDTH. Table 1-1 shows the sensitivity and bandwidth of the EMC-25 Interference Analyzer.

1.3.6 SPURIOUS REJECTION. Rejection to Image and IF, and other spurious frequencies typically exceeds 60 DB and is never worse than 45 DB throughout the entire 14 KHz to 1000 MHz range.

1.3.7 VOLTAGE RANGE. The analyzer is capable of measuring signals as large as 1.0 V RMS. Voltage ranges are obtained by means of a step attenuator; 20 DB per step. Overall front panel meter range is 60 DB attenuation for full scale readings. Front-end attenuation is inserted in all positions except the most sensitive.

1.3.8 FREQUENCY CONTROL. The analyzer is tunable over any single band by means of a front panel control or by the application of a suitable voltage to a front panel connector.

Frequency bands are switched by a single front panel control or optionally by means of a remotely controllable internal stepping motor. The remote band indication is accomplished by means of binary switch closures.

TABLE 1-1

SENSITIVITY AND BANDWIDTH

BAND	FREQUENCY RANGE	BW (3 DB) NB (Nominal Bandwidths)	BW (3 DB) WB (Nominal Bandwidths)	SENSITIVITY *CW (NB) (uV)	SENSITIVITY (IMPULSE (WB) (DB/uV/KHz)
1	14.0 KHz-28.5 KHz	500 Hz	4 KHz	.03 to .06	-32 to -26
2	28.5 KHz-59.0 KHz	500 Hz	4 KHz	.03 to .06	-32 to -26
3	59.0 KHz-120 KHz	500 Hz	4 KHz	.03 to .06	-32 to -26
4	120 KHz-240 KHz	500 Hz	4 KHz	.03 to .06	-32 to -26
5	240 KHz-480 KHz	500 Hz	4 KHz	.03 to .06	-32 to -26
6	.48 MHz-1.05 MHz	500 Hz	5 KHz	.03 to .06	-32 to -26
7	1.05 MHz-2.30 MHz	500 Hz	5 KHz	.03 to .06	-32 to -26
8	2.30 MHz-5.00 MHz	5 KHz	50 KHz	.06 to .12	-47 to -41
9	5.00 MHz-11.0 MHz	5 KHz	50 KHz	.06 to .12	-47 to -41
10	11.0 MHz-25 MHz	5 KHz	50 KHz	.06 to .12	-47 to -41
11	24 MHz-49 MHz	50 KHz	500 KHz	0.4 to 0.8	-50 to -44
12	49 MHz-98 MHz	50 KHz	500 KHz	0.4 to 0.8	-50 to -44
13	98 MHz-210 MHz	50 KHz	500 KHz	0.4 to 0.8	-50 to -44
14	210 MHz-490 MHz	50 KHz	500 KHz	0.5 to 1.0	-48 to -42
15	490 MHz-1000 MHz	50 KHz	500 KHz	0.8 to 1.6	-44 to -38

*NOTE: Tangential Sensitivity -- defined as the internal noise level or as the input signal level required to raise the meter reading 3 DB above the instrument noise. Tangential Sensitivity level is at least 8 DB above minimum discernible signal (MDS). MDS is sometimes defined as being 0.5 DB above the noise level.

1.3.9 DETECTOR FUNCTIONS

1.3.9.1 CARRIER. Responding to the RMS value of an unmodulated sine wave and having nominal 600 milliseconds charge and discharge times.

1.3.9.2 QUASI-PEAK. As in CARRIER except nominal charge time is 1 millisecond and discharge time 600 milliseconds.

1.3.9.3 PEAK. As in CARRIER except charge time is $<< \frac{1}{BW}$ and discharge time is sufficiently long to read an impulse of 10 PPS rep rate with less than 1 DB decrease in accuracy.

1.3.9.4 SLIDEBACK. A metered indication of the detector biasing required for aural extinction of signals.

1.3.10 OUTPUTS

1.3.10.1 POST-IF: 1.0 MV RMS nominal into 50 ohms.

1.3.10.2 PRE-IF: 50 uv RMS nominal into 50 ohms.

1.3.10.3 VIDEO: 50 mv PEAK nominal into 91 ohms.

1.3.10.4 AUDIO: 100 mw nominal into 600 ohms.

1.3.10.5 RECORDER, external meter: 1 ma at 1500 ohms.

1.3.10.6 X-Y PLOTTING: Y-axis 0 to 1.5 VDC into 1.5K ohms $\pm$ 1%.

1.3.11 CALIBRATION. The instrument includes a built-in wideband calibration system.

1.3.12 POWER REQUIREMENTS. The analyzer operates from 105 V to 130 V, or 210 V to 260 V, 50-450 CPS, as well as from its own internal battery supply, or from an external DC source.

Switching between internal supply and external supply is automatic when connected to external supply.

The EMC-25 is supplied with AC power cord, instruction manual, alignment tools and certificate of performance.

SECTION II
THEORY OF OPERATION

2.1 GENERAL

Interference Analyzer Model EMC-25 is an accurately calibrated superheterodyne receiver. Its dynamic range, measured from noise to the overload point (with optimum fixed setting of the input attenuator) is in excess of 80 DB. Most parameters are remotely programmable through either voltage application, resistance change or contact closure to the front panel REMOTE connector, as well as manually controllable. Reference to the block diagram (Figure 2.1) will aid the understanding of EMC-25 operation.

2.2 POWER SUPPLY

To permit field operation and reduce the possibility of ground loops in laboratory work, a nickel-cadmium battery is used for the primary power supply. The battery additionally serves the useful purpose of a pre-regulator for AC line operation. In the battery charger compartment are located a constant current supply for charging the battery and a high voltage converter. High impedance of those power lines entering the main circuit section facilitates a high degree of filtering. The low voltage series-regulated

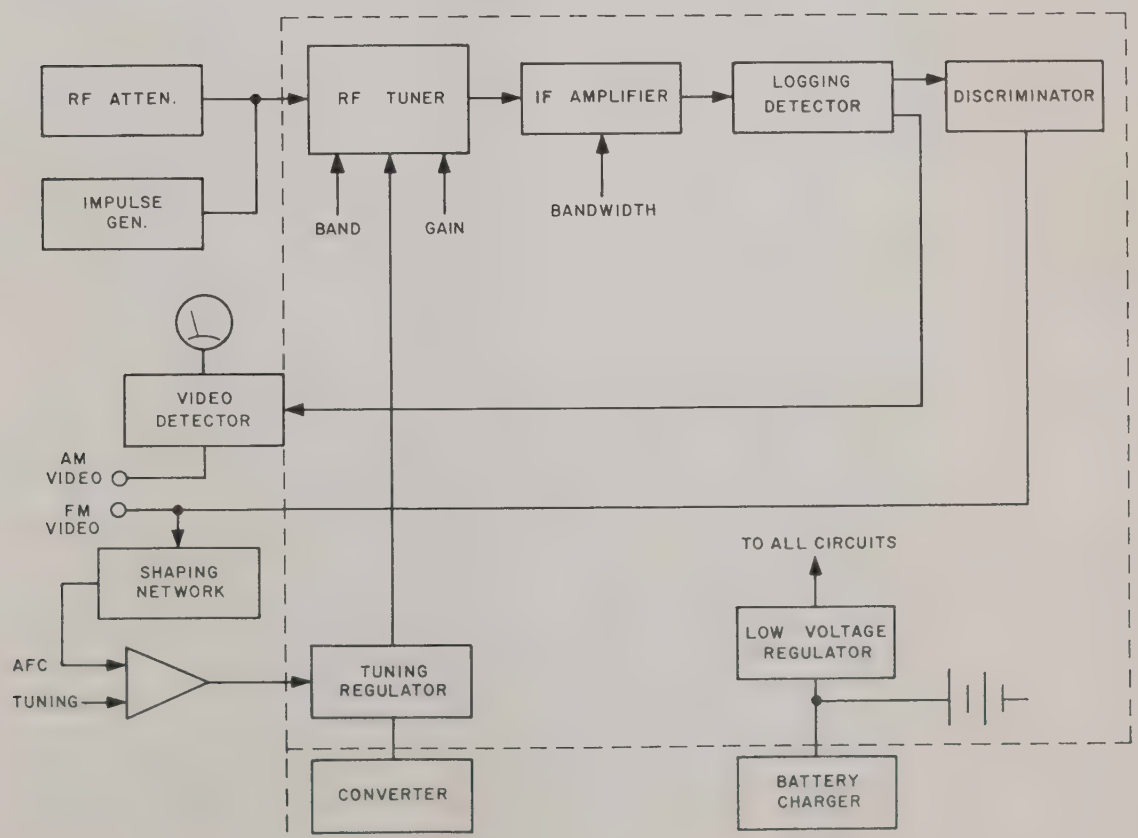


Figure 2.1 Block Diagram, Interference Analyzer, Model EMC-25

power supply and the tuning voltage regulator follow fairly conventional design practice.

2.3 ATTENUATORS AND RF TUNER

A single control having 20 DB increments is used to adjust the input signal level to the instrument. Both RF and IF attenuation are provided by this control. The first attenuator step avoids RF attenuation and thus provides maximum sensitivity of the instrument, whereas further attenuation steps add RF attenuation to improve both the input impedance and the signal-to-noise ratio displayed on the output meter.

The RF tuner assembly provides for preselection, heterodyning to the IF frequency and preamplification at the IF frequency. To provide adequate image and spurious rejection, tuned circuits are used both ahead of the RF amplifier and after it. To conserve battery power and provide for remote electronic tuning, varactors are used to tune these circuits as well as the local oscillator. The use of varactors provides another bonus in that their compact size permits the use of a turret tuner in which all active elements are located on the fixed, or "stator", portion and need not be duplicated for each tuning band and passive L-C network can be located on individually replaceable strips on a rotating assembly, or "rotor". The ability of the varactor-tuned circuits to tune slightly more than an octave permits the use of only 15 segments on this rotor.

On bands above 25 MHz lead lengths and circuit techniques dictate the use of active circuits located within the rotor itself for the RF amplifier, first mixer and first and second local oscillators. On some of these bands a second conversion is also used. To achieve adequate stability and tuning range on these higher bands, selected components and, in many cases, multiple tuning elements have to be used. A motor and clutch activated by a transistor switch are utilized to rotate the band-switching drum assembly from a remote location.

Three separate IF channels, each with a dual bandwidth, are necessitated by the extremely wide frequency coverage of the instrument. 175 KHz, 1.6 MHz, and 8.7 MHz are used to assure adequate image rejection and for convenience in obtaining the desired bandwidths.

Preamplifiers for the three IF channels are also included in the tuner and a common three-transistor amplifier with a light-dependent resistor in its feedback loop is used for remote gain control.

2.4 IF AMPLIFICATION

To achieve the required selectivity, the multiple-stage IF amplifier utilizes under-coupled synchronously-tuned circuits. Bandwidth control is achieved locally and remotely by diode switching a single narrow-band tuned stage in series with the signal path. The circuit design is such that from the input of the receiver to the output of the IF amplifier greater than 80 DB dynamic range is maintained between the noise floor and the limit level.

2.5 LOGGING DETECTOR

A seven-stage sequential detection system is used for a logging detector following each IF amplifier. This is unique in its simplicity in that no tuned circuits or delay lines are used. Matched precision components preclude the need for any adjustment of this circuit other than the maximum and minimum scale points. There are two outputs from the circuit. One is a limited IF signal, the other a DC-coupled reproduction of the logged envelope of the signal.

2.6 DISCRIMINATOR

Each limited IF output is fed to an amplifier and discriminator circuit. This discriminator provides DC-coupled FM video information, as well as an error signal to operate the AFC system. The bandwidth of each of the three discriminators exceeds the 3 DB bandwidth of its respective IF amplifier.

2.7 VIDEO DETECTOR

The video detector is located at the interface between the heavily-shielded and non-shielded portions of the analyzer. Its purpose is to further detect and apply the correct time constant to the signal envelope waveform supplied by the logging detector. To obtain accurate linear detection at this point, as well as the extremely long stretch times required for peak detection, an active detector with a differential FET input stage is used. Certain applications involving the use of slow speed recorders and peak detection in the analyzer require the periodic "dumping" of the charge in the detector circuit. To determine how long a signal is to be held in the peak detector circuit before being dumped, a linear differential amplifier is utilized to sense

the rate of amplitude change of detected signals and to vary the dump time accordingly. The output of the video detector feeds both the internal indicating meter and the analyzer's "Y-output".

2.8 CONTROL SECTION

All manual controls, calibrator, audio amplifier, and tuning comparator are located in the control section. All components located in this section are relatively non-susceptible to interference and thus do not need to be well shielded.

The calibrator is a mercury-wetted reed switch charged coaxial line, the switch being driven at an 18 pulse per second rate by a multivibrator.

The audio amplifier provides 100 milliwatts output to 600 ohm earphones as well as a detected output which, in the AM or FM position of the detector function switch, feeds to the internal meter an indication of modulation levels of incoming signals.

A differential amplifier compares the zero to +1.5 volts tuning voltage from either the manual pot or an external source with the AFC error voltage. A one-minute linear sweep generator is also included on this circuit board to provide a single scan of any selected band for use with most X-Y recorders. The DC output of this differential amplifier provides the "X-output" voltage of this instrument as well as the input to the tuning voltage regulator previously mentioned as part of the power supply.

2.9 ACCESSORIES

The potential usefulness of the EMC-25 with its capability for automatic operation would be severely restricted if the pick-up devices associated with it must be laboriously switched by hand. To avoid this limitation, both rod and loop antennas covering the 14 KHz to 25 MHz range are designed to switch automatically in synchronism with the EMC-25 band selector. Antennas for frequencies between 25 MHz and 1 GHz are broadbanded so that no switching is required.

To assist those users for whom a semi-automatic interference analysis system is desirable, the ESC-125A Programmer and EXY-125 Recorder are available. In conjunction with Electro-Metrics EMC-10, used over the frequency range of 20 Hz to 15 KHz, the EMC-25 and a variety of pick-up devices, this programmer and recorder permit the entire frequency range from 20 Hz to 1 GHz to be scanned at the push of a button and permanently recorded. The design also allows for selecting any segment of this frequency range to be covered and for the pick-up devices to be switched automatically to the analyzer inputs at predetermined frequencies.

SECTION III
OPERATION INSTRUCTIONS

3.1 GENERAL

3.1.1 This section provides instructions for operation of the Interference Analyzer, Model EMC-25 in all modes. Instructions are also included for pre-operating calibrations, accessory operation and reading interpretation.

CAUTION

Read all information in this section carefully before attempting operation. Improper operation can cause costly damage to the instrument.

3.2 UNPACKING

3.2.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform the manufacturer and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

3.2.2 Check contents of the carton against shipping slip to be sure that all components and accessory items ordered are present. Notify the manufacturer immediately of any missing items.

3.3 ELECTRONIC SHIPPING DAMAGE

3.3.1 Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore, to check the operation of the instrument as soon as possible after unpackaging.

To do so, perform the calibration tests outlined in paragraph 3.7. If the instrument does not calibrate using the referenced procedures, inform the manufacturer giving the basic information required in paragraph 3.2.1.

3.4 POWER REQUIREMENTS

3.4.1 Unless otherwise specified on the purchase order, the EMC-25 is normally wired for operation with the following power supplies.

a) Internal (self-contained) battery operation.
b) External 105 to 130-volt AC, at 50 to 450 Hz.
c) External 30 to 56-volt DC.

NOTE

A switch on the battery charger compartment cover changes power supply to operate from 105 to 130 volts AC or 210 to 260 volts. The fuse must be changed as indicated when changing the supply voltage range.

3.5 BATTERY POWER SUPPLY

3.5.1 The battery pack (BAT-25) supplied with the instrument incorporates multiple nickel-cadmium cells in a modular design which provides for individual cell replacement. The battery can be used for eight hours of sustained operation without recharging. It will fully recharge after such usage in sixteen hours. To recharge the battery, connect the instrument to an external AC source. Battery charging is automatically controlled by the instrument and will occur with the POWER switch either in the ON (up) or OFF (down) positions. This provides operating capability during the recharging phase.

3.5.2 Because testing with this instrument is usually performed sporadically for short periods of time, it is difficult to know the charge condition of the battery. The front panel Battery Test Switch indicates only if the regulating circuits are operating properly. It does not indicate exact degree of charge or balance condition of the battery or of voltage to the instrument. The battery test light will light when the switch is depressed if the EMC-25 is operable.

3.5.3 For most efficient operation this instrument should be connected to an external AC source, whether turned OFF or ON, and kept on charge even when in storage. It cannot be overcharged.

3.5.4 The internal battery is automatically used when the instrument is fully disconnected from the power line. Normally the instrument should be kept on AC and near full charge at all times for best overall operation.

3.5.5 The instrument can also be operated from an externally connected battery. To do so, connect the PDC-25 power cord to the power input connector on the rear of the instrument, then connect the red clip to the positive battery terminal and the black clip to the negative battery terminal.

CAUTION

Do not ground the battery terminals or establish a reference ground. Let the external supply "float" above ground. The internal battery must be left in the instrument and connected when the instrument is being operated from external AC or DC operation to provide proper capacity.

3.6 INSTALLATION

3.6.1 The EMC-25 is designed for bench-top operation, field-portable operation, or for installation in a conventional 19-inch equipment rack.

3.6.2 Rack mounting requires the use of two adapter mounting brackets (ABM-25). Using these brackets, install the instrument by the following procedure. (See Figure 3.1.)

a) Remove the four plastic feet.
b) With six 3/8-inch No. 10-32 binder head screws, fasten brackets to sides of instrument at matching screw holes.
c) Before installing in equipment rack, provide underneath support sufficient to carry the weight of the instrument.

3.7 PRE-OPERATIONAL CALIBRATIONS

3.7.1 All measurements made with the EMC-25 are based on its calibration as a two-terminal voltmeter. The built-in calibration standard is an impulse generator whose spectrum is essentially flat between 14 KHz and 1 GHz. CW calibration charts, made necessary by front end gain variations and slight overall bandwidth variations, are provided for each instrument. Calibration charts are also provided for making broadband measurements. Figure 3.2 is a typical calibration chart. Figure 3.3 illustrates front panel controls for calibration. Figure 3.4 shows all panel controls and paragraph 3.10 details all functions.

3.7.2 CW CALIBRATION. To calibrate the EMC-25 for directly reading signal levels in

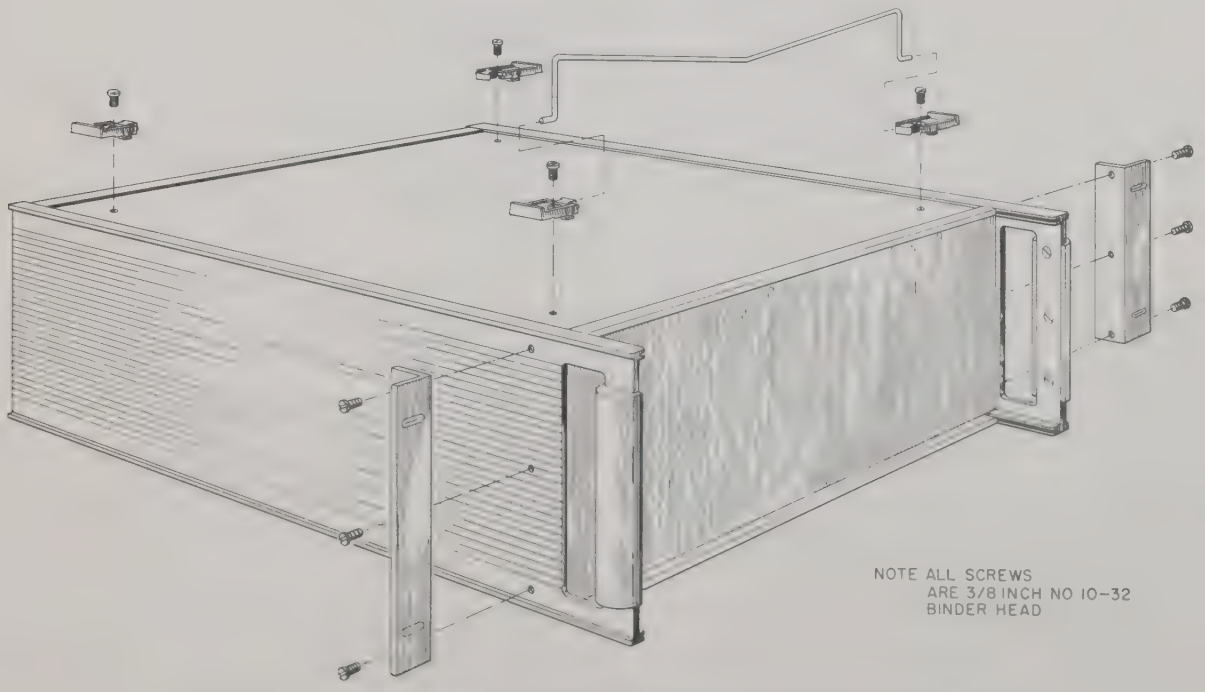


Figure 3.1 Interference Analyzer (Inverted), Installation Drawing

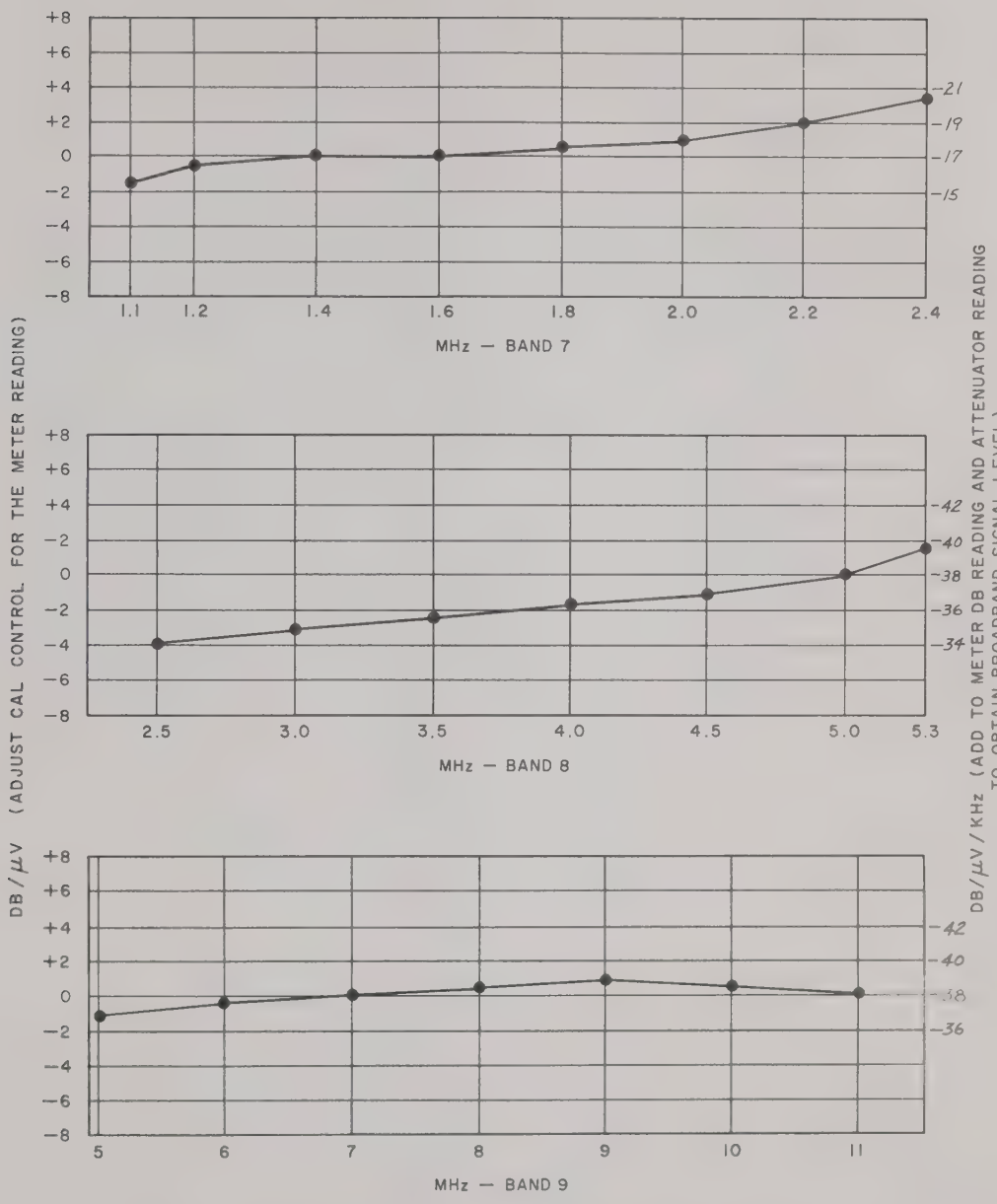


Figure 3.2 Typical Calibration Chart - Broad and Narrow Band

microvolts or DB above one microvolt proceed as follows:

a) Set controls:
ATTENUATOR - CAL (20 DB on black scale)
FREQUENCY - As required
TUNING MODE - Manual
TUNING AID - Off
DETECTOR FUNCTION - Peak
BANDWIDTH - Wide
DUMP - Full CCW

NOTE

Proper operation of the impulse generator, utilized as the built-in calibration standard, requires that the EMC-25 be physically situated within 30° of horizontal. Also, when operating normally, a moderate amount of "bounce" in the meter reading of the calibration standard is to be expected. The operator visually must average the reading to set the level specified on the chart.

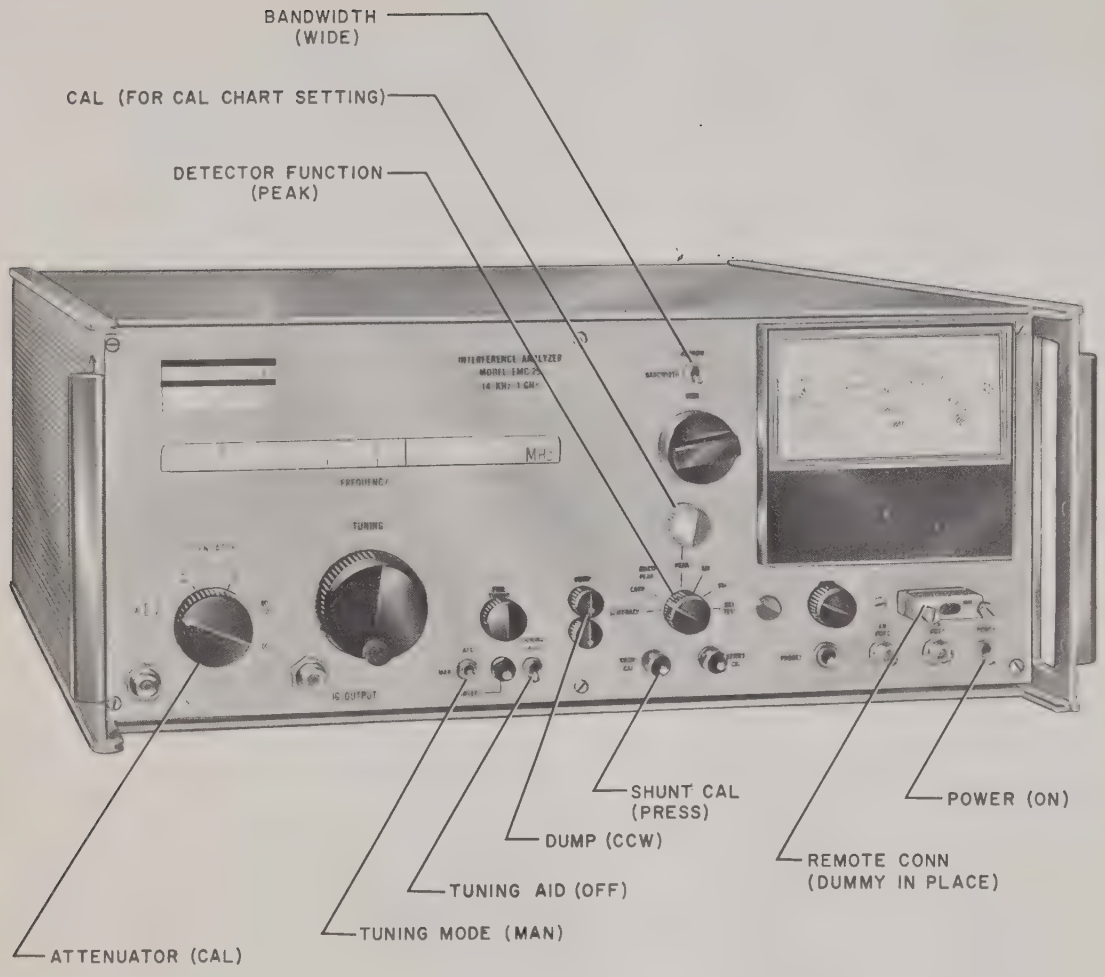


Figure 3.3 Control Settings for Calibration

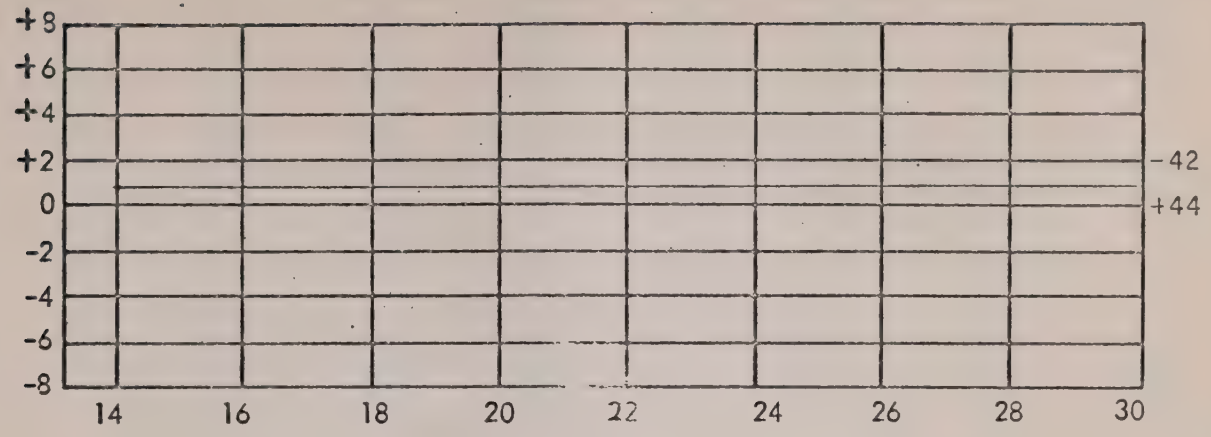
b) Depress the SHUNT CAL button and simultaneously rotate the CAL knob until the meter indicates the DB value shown on the left-hand scale of the calibration chart. (Figure 3.2 is a typical chart.) (Proper settings are approximately 20 DB below full scale.)

c) The instrument is now calibrated. DB above one microvolt may now be read by algebraically adding the DB value shown on the meter to that indicated at the ATTENUATOR setting. The black values to be used below 25 MHz (Bands 1-10) and the orange above 25 MHz (Bands 11-15).

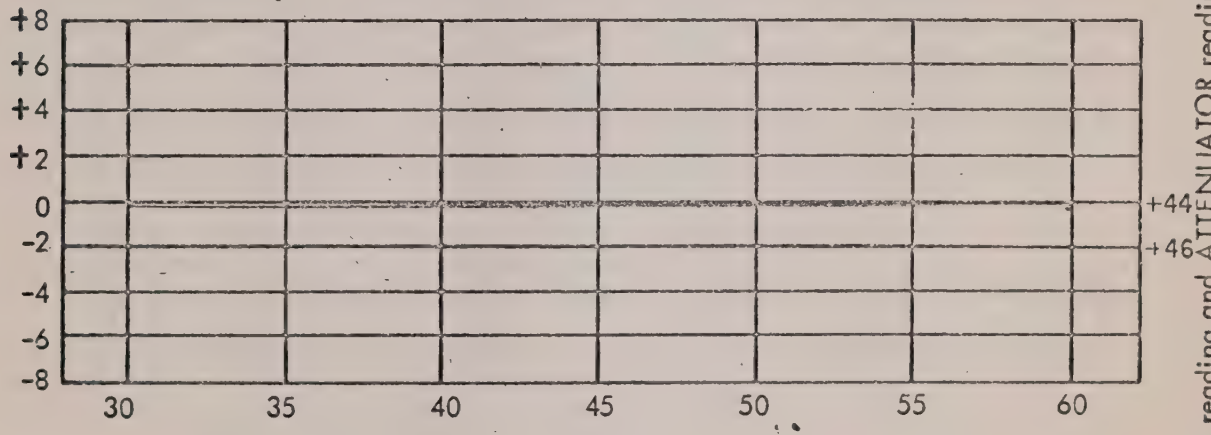
For the bands covering up to 25 MHz (white frequency scale), microvolt values may be read directly from the meter when the attenuator is in the 0 DB position. Full scale values for the various attenuator positions (orange or black) are as follows:

ATTENUATOR	FULL SCALE VOLTAGE
0 (black only)	10 uv
20	100 uv
40	1 mv
60	10 mv
80	100 mv
100	1 v

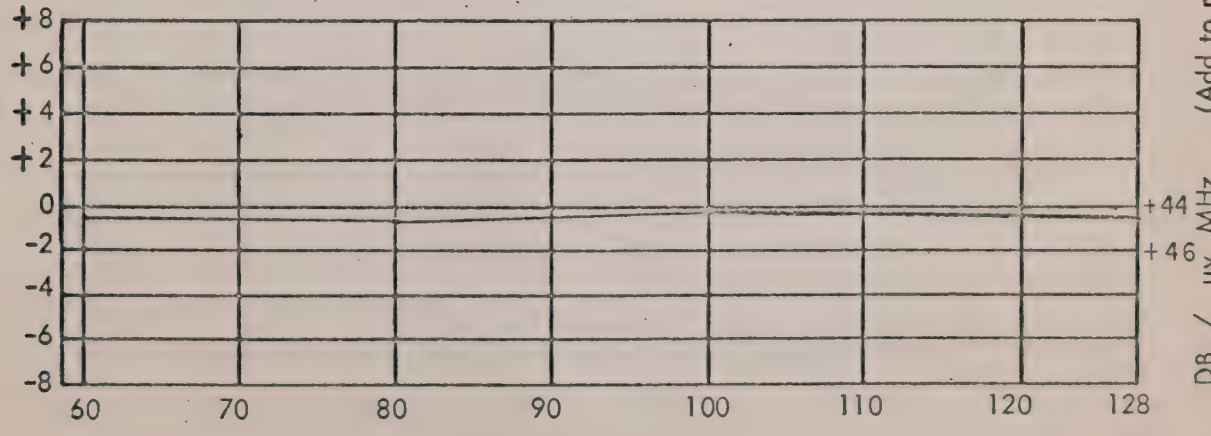
d) Set the DETECTOR FUNCTION switch and ATTENUATOR as required by the signal being measured. The BANDWIDTH switch may be set to either Wide or Narrow, as required by the signal bandwidth or noise considerations.



KHz - Band 1



KHz - Band 2



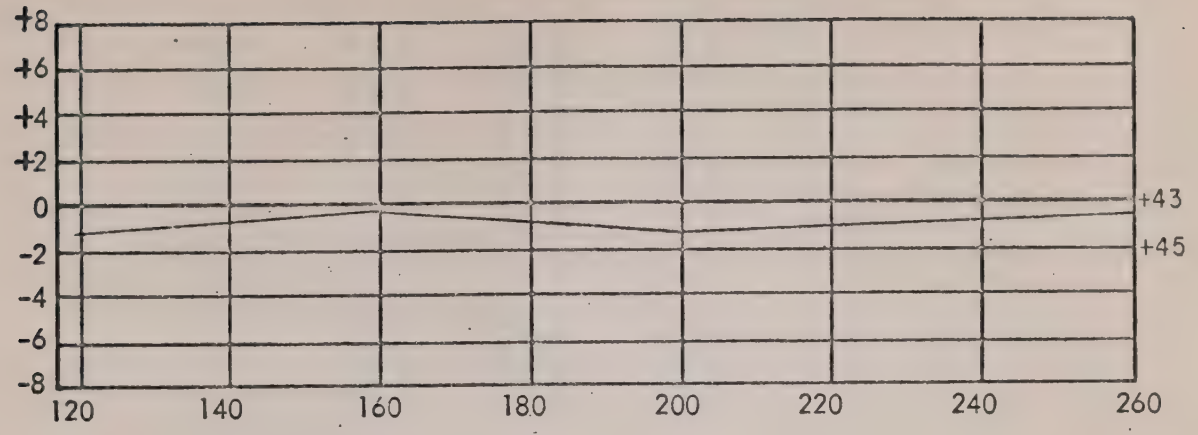
KHz - Band 3

DB / uv (Adjust CAL control for this meter reading.)

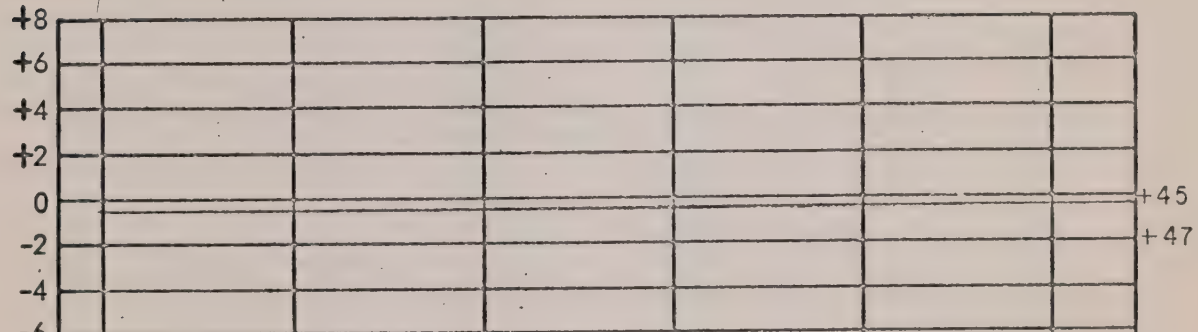
DB / uv MHz (Add to meter DB reading and ATTENUATOR reading to obtain Broadband Signal Level.)

CALIBRATED BY: MC DATE: 10-5-67

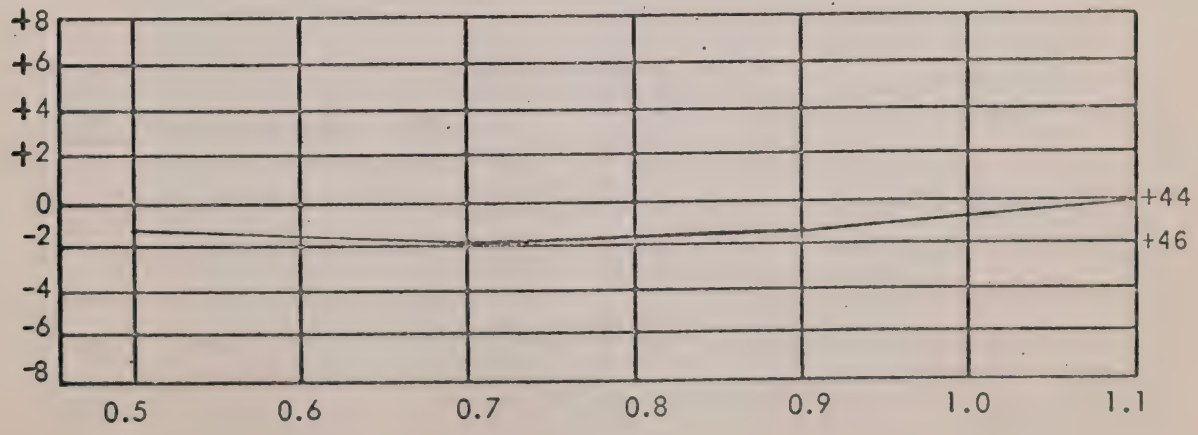
EMC - 25 SERIAL NUMBER: 250078



KHz - Band 4



KHz - Band 5



MHz - Band 6

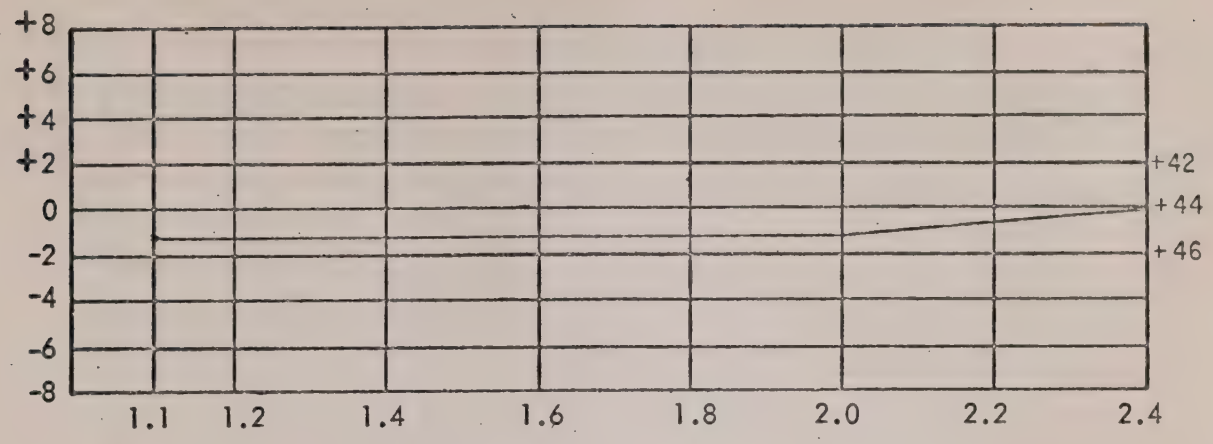
DB / uV (Adjust CAL control for this meter reading.)

DB / uV / MHz (Add to meter DB reading and ATTENUATOR reading

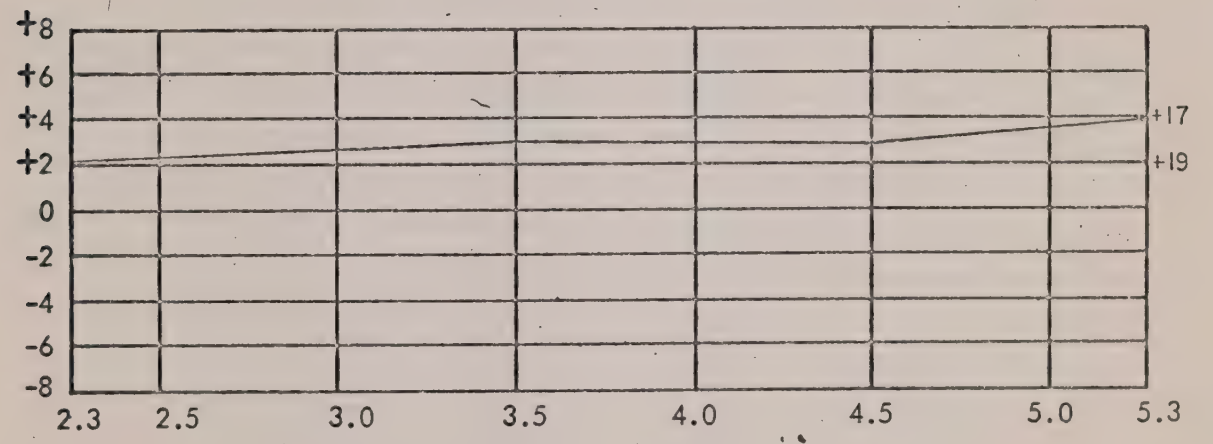
CALIBRATED BY: MC DATE: 10-5-67

EMC-25 SERIAL NUMBER: 250078

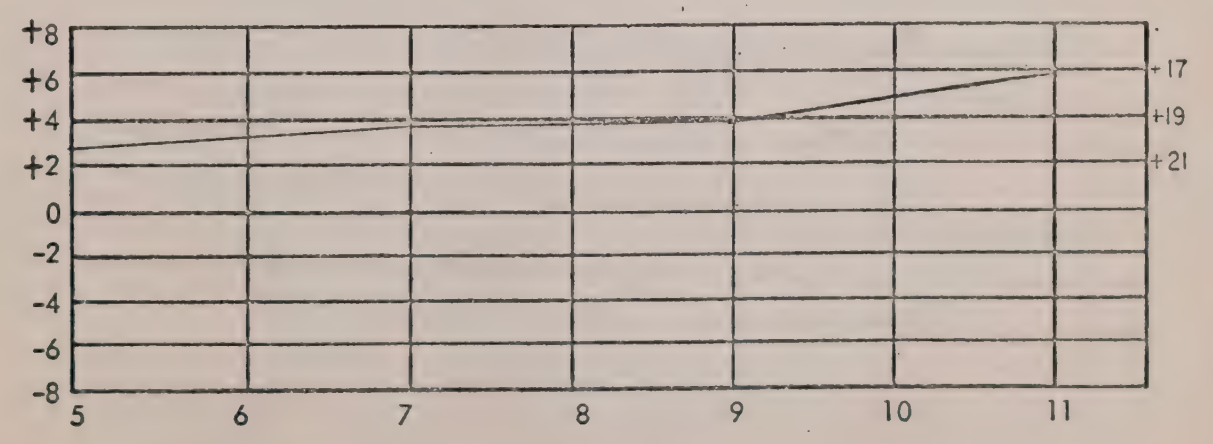
CALIBRATION CHART - BROAD AND NARROW-BAND



MHz - Band 7



MHz - Band 8



MHz - Band 9

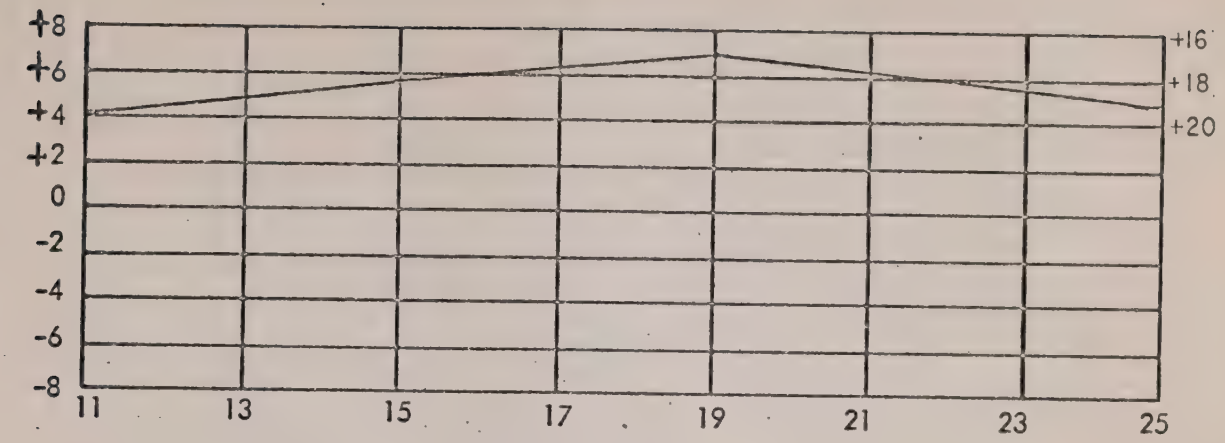
DB / uV (Adjust CAL control for this meter reading.)

DB / uV / MHz. (Add to meter DB reading and ATTENUATOR reading to obtain Broadband Signal Level.)

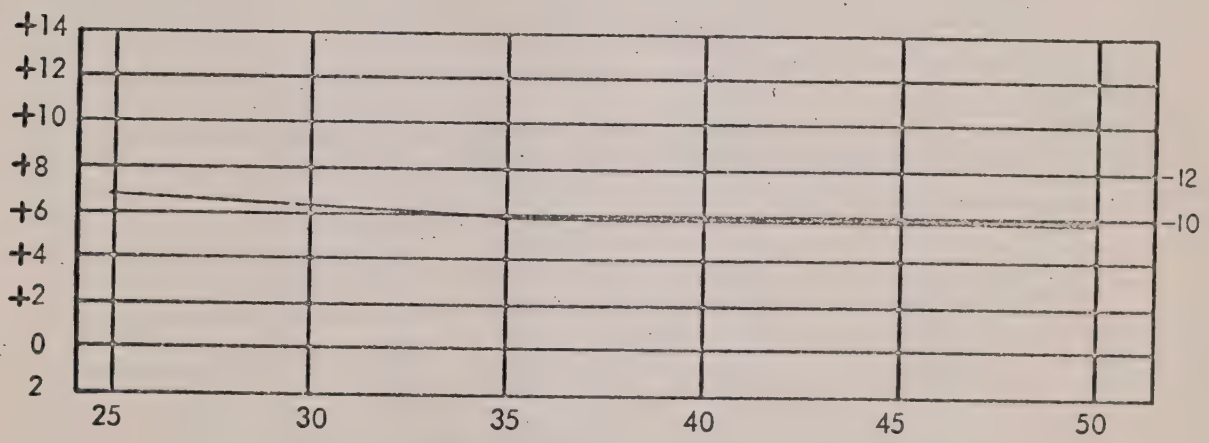
CALIBRATED BY: MC DATE: 10-5-67

EMC - 25 SERIAL NUMBER: 250078

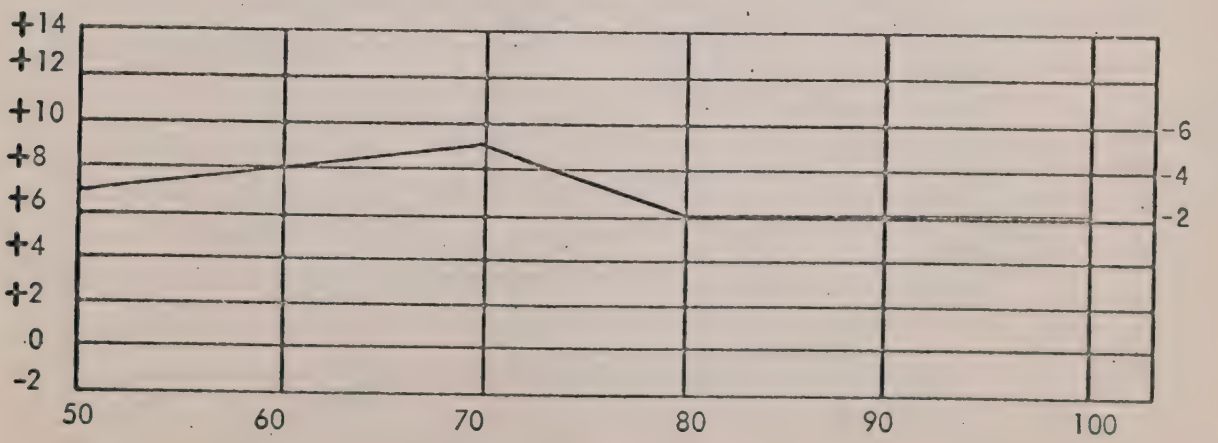
CALIBRATION CHART - BROAD AND NARROW-BAND



MHz - Band 10



MHz - Band 11



MHz - Band 12

(Adjust CAL control for this meter reading)

DB/uV

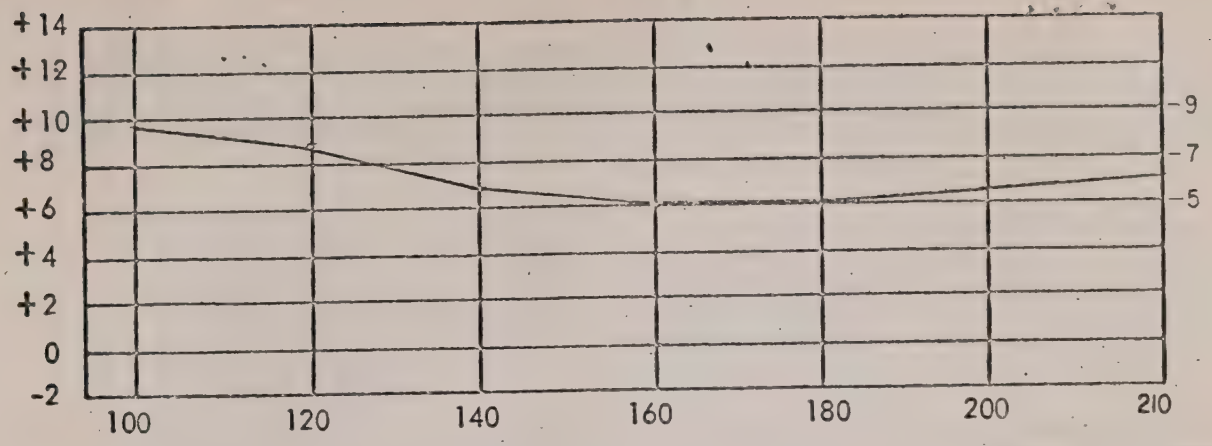
(Add to meter DB reading and ATTENUATOR reading to obtain Broadband Signal Level)

DB/uV/MHz

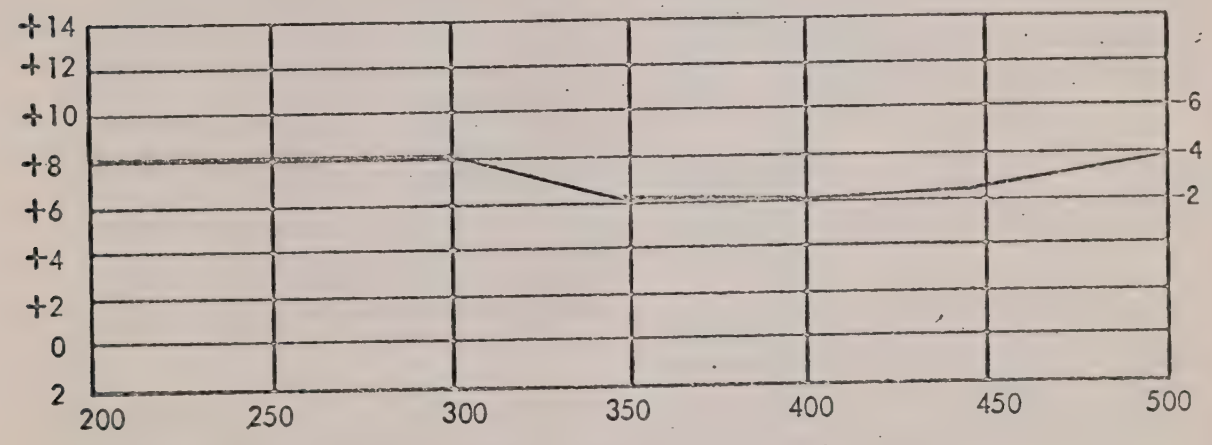
Calibrated by MC Date 10-5-67

EMC-25 Serial No. 250078

CALIBRATION CHART - BROAD AND NARROW BAND

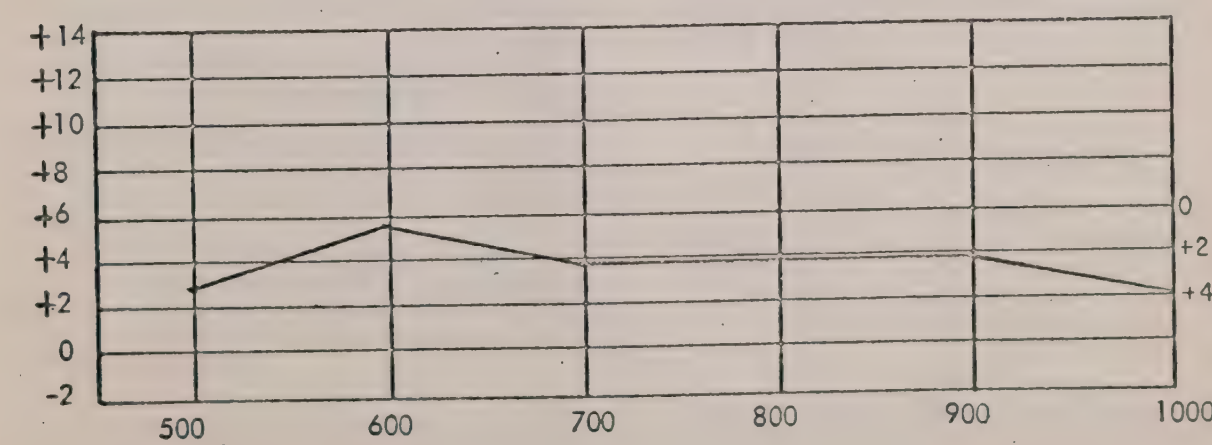


MHz - Band 13



MHz - Band 14

DB/uV (Adjust CAL control for this meter reading)



DB/uV/MHz (Add to meter DB reading and ATTENUATOR reading to obtain Broadband Signal Level)

MHz - Band 15

Calibrated by MC Date 10-9-67

EMC-25 Serial No. 250078

CALIBRATION CHART - BROAD AND NARROW BAND

3.7.3 BROADBAND CALIBRATION. To calibrate the EMC-25 for reading signal levels in DB above one microvolt per megahertz or DB above one microvolt per kilohertz, proceed as follows:

a) Set controls:
ATTENUATOR - CAL (20 DB on black scale)
FREQUENCY - As required
TUNING MODE - Manual
TUNING AID - Off
DETECTOR - Peak
BANDWIDTH - Wide
DUMP - Full CCW

b) Depress the SHUNT CAL button and simultaneously rotate the CAL knob until the meter indicates the DB value shown on the left-hand scale of the calibration chart. (See note in paragraph 3.7.2.a.)

c) The instrument's gain is now set properly. To read signals in terms of DB-above-one-microvolt-per-kilohertz, algebraically add the DB values on the right-hand scale of the calibration chart to the meter reading and those indicated around the ATTENUATOR. The black values are to be used below 25 MHz (bands 1-10) and the orange above 25 MHz (bands 11-15). Algebraically add an additional +60 DB if DB-above-one-microvolt-per-megahertz readings are desired.

3.8 OPERATION

Operation of the Interference Analyzer Model EMC-25 may be performed manually or by remote control. Most major functions can be remotely programmed through the front panel REMOTE connector. Each of the functions is described separately, but any number of them can be performed simultaneously without interaction. A number of useful outputs are also available at this connector. Systems applications are so numerous and varied that only interfacing requirements are covered in this section.

Caution should be exercised in proper connection and operation within the limits described. Damage can result to the instrument if voltages or impedances other than those specifically stated are applied.

3.9 OPERATIONAL PRECAUTIONS

3.9.1 DUMMY PLUG. Normal manual operation can be achieved only when the dummy multiple-pin connector furnished with the instrument is securely in place on the front panel.

3.9.2 INPUT VOLTAGE. Damage to the input attenuator may result if signals larger than 5 volts RMS are applied continuously. Pulsed signals must be of less than 0.5 watt average power and 500 watts peak power.

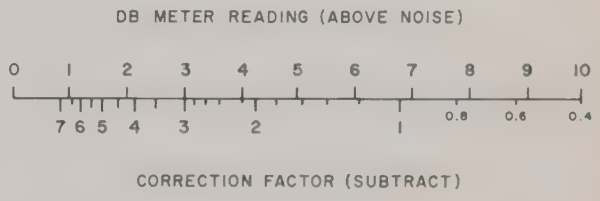
3.9.3 OFF FREQUENCY SIGNALS. Any superhet receiver such as the EMC-25 generates spurious signals when one or more high-level signals are applied to its input. The exact amplitude of the resultant signal is dependent on so many variables that specific prediction is not feasible.

Despite the many design precautions taken to minimize such responses, they will appear under some conditions. One method of determining whether a signal is spurious or not is to increase the input attenuation by 20 DB and note which signals drop by that amount. Any signals decreasing by more or less than 20 DB are spurious. The SPA-125 Spectrum Analyzer accessory is a useful aid in this regard.

3.9.4 AUDIO OUTPUT. Use of low-impedance earphones or of a resistive load of less than 600 ohms will result in poor frequency response, distortion, and low power output.

3.9.5 TUNING ACCURACY. Stated tuning accuracy is met with the FINE TUNE control at mid-rotation. The FINE TUNE control is intended only for tuning narrow-band signals in the high frequency range and to compensate for discriminator offset when using AFC.

3.9.6 AMPLITUDE ACCURACY. For signals close to the noise level of the instrument, a correction must be made. Use the scale below.



Top Scale is that increase in DB in meter reading over noise level when input signal is applied.

Bottom Scale is that amount in DB to be subtracted from total meter reading to find actual signal level.

EXAMPLE:

Internal Noise	-30 DB (above 1 uV)
Meter indication with signal applied	-25 DB
Increase in meter reading (30-25)	5 DB
From scale: amount to be subtracted . . .	1.65 DB
Actual signal level equals:	

[(-25) - 1.65 = -26.65 DB (above 1 uV)]

The EMC-25 cannot be satisfactorily calibrated when the TUNING AID or AFC are in operation. Carriers can be measured with AFC on only if the signal has been peaked on the meter using the FINE TUNE control. The TUNING AID must be off while measuring amplitude.

3.10 CONTROL FUNCTIONS (Figure 3.4)

3.10.1 ATTENUATOR. The attenuator adds attenuation to the RF and IF circuits in 20 DB increments. The black numbers are added to the meter reading to obtain the proper scale multiplier below 25 MHz. The orange backed numbers are used above 25 MHz.

3.10.2 TUNING. The main manual frequency control for the instrument, it causes the cursor of the Frequency dial to move and indicate the frequency to which the instrument is tuned.

3.10.3 FINE TUNING. A vernier control covering approximately one percent of a band, it is used to facilitate tuning of narrow-band signals and is especially useful on the higher bands.

3.10.4 TUNING MODE. A three-position selector switch which determines whether tuning is to be done manually without AFC, manually with AFC, or whether the internal sweep circuit is energized.

3.10.5 SWEEP START. Resets the internal sweep circuit to the low end of the band. Upon its release the receiver sweeps upward in frequency linearly with time, reaching the upper

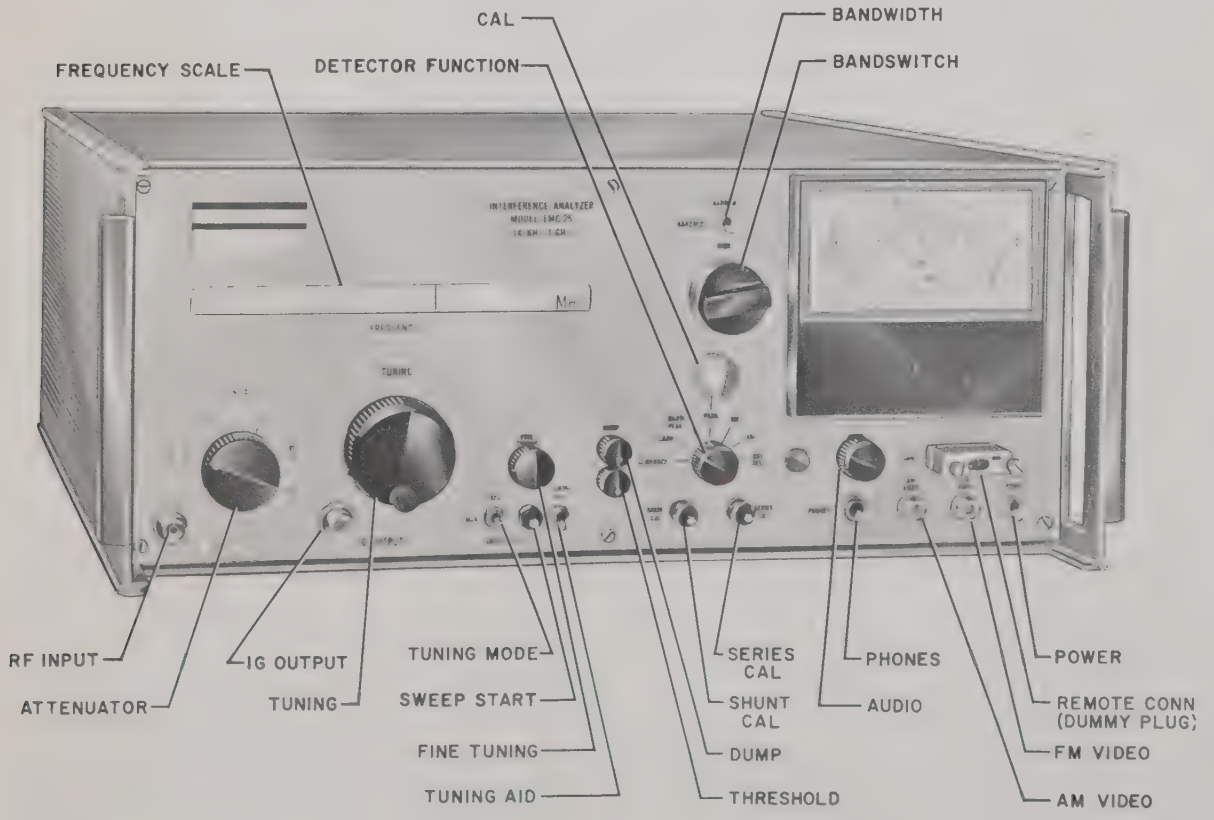


Figure 3.4 EMC-25 Front Panel Connectors and Controls

band limit in approximately one minute. The X-output voltage available at the Remote Connector also varies in accordance with the frequency sweep.

3.10.6 TUNING AID. Used to aurally locate weak unmodulated signals.

3.10.7 SHUNT CAL. Activates the impulse generator calibrator and connects it to the receiver input.

3.10.8 SERIES CAL. Activates the impulse generator calibrator and connects it to the IG OUTPUT jack.

3.10.9 DETECTOR FUNCTION. Determines the detector time constant and switches the meter to read either detector output or modulation level.

3.10.10 DUMP. Adjusts the length of time the detector "holds" a signal level when the Detector Function switch is in the "Peak" mode. Extreme counter-clockwise rotation deactivates the "dump" circuit resulting in normal peak detection.

3.10.11 THRESHOLD. Adjusts the aural extinction point when the Detector Function switch is in the "Slideback" mode.

3.10.12 AUDIO. Adjusts the audio output level at the phone jack and the reference level for the "AM" and "FM" Modulation positions of the Detector Function switch.

3.10.13 BANDSWITCH. Manually switches the desired band into position.

3.10.14 BANDWIDTH. Switches the receiver to either the wide or narrow bandwidth with respective values specified for the frequency band selected.

3.10.15 CAL. Adjusts the receiver gain to permit amplitude calibration.

3.10.16 POWER. Used to place the instrument in operation.

3.11 DETECTOR FUNCTIONS

3.11.1 GENERAL. Careful use of the DETECTOR FUNCTION switch, BANDWIDTH switch and associated controls can yield much information about the type of signal being received. Some functions are useful only for manual use while others can be used both manually and automatically.

3.11.2 SLIDEBACK. Having performed the Broadband Calibration (paragraph 3.7.3), very weak signals or adjacent signals having different repetition rates may be measured aurally using the slideback function.

a) Calibrate according to 3.7.3.
b) Turn the ATTENUATOR to obtain a reading "on scale".
c) Plug in PHONES. Turn AUDIO CW. Turn THRESHOLD CW.
d) Adjust AUDIO so that background hiss can barely be heard.
e) Adjust THRESHOLD until peaks of the signal being measured are heard, then turn CW slowly until they just become inaudible.
f) Read meter and add correction factors as in paragraph 3.7.3.c.

Alternately, if an external variable broadband signal source is available, it can be substituted for the unknown signal to determine its amplitude.

3.11.3 CARRIER. In the CARRIER position, the meter indicates the RMS value of the carrier with all modulation stripped off by the meter's time constant. When using this position it should be remembered that high peak signal levels might overload the EMC-25 and result in erroneous readings. If the DETECTOR FUNCTION switch is first placed in PEAK and the ATTENUATOR adjusted so that full scale meter deflection is not exceeded, the CARRIER function can then be used with assurance that overload will not occur.

3.11.4 QUASI-PEAK. In the QUASI-PEAK position, the metering circuitry provides a 1 millisecond charge time constant and a 600 millisecond discharge time constant over the entire meter scale. Since vacuum-tube-type instruments typically do not have the same time constants over the entire metering range, measurements among various such instruments will not agree. Similarly, Quasi-Peak instruments made with the EMC-25 probably will not agree at all levels with those made on a measuring set with vacuum tube circuitry.

3.11.5 PEAK. The PEAK measurement circuit has a rise time much shorter than the reciprocal of the IF amplifier rise time. Fall time is greater than 10 seconds with the DUMP control fully counterclockwise (the normal position for manual operation). The PEAK circuit is calibrated in terms of the RMS value of an unmodulated carrier and should read the same as CARRIER for unmodulated signals. Pulsed RF signals will be read as the RMS value of the carrier at the peak of the modulation. There

are no significant low repetition rate errors until the rate is below one pulse per second. Pulse response is also altered by the IF bandwidth and its near-gaussian characteristic.

3.11.6 AM MODULATION. The detector is turned into a video voltmeter in the AM Modulation position so that a variety of measurements of the amplitude modulation of carriers can be made. The 0 to 100 percent scale used for modulation measurements is linear and the 3 DB-down, frequency response points are below 20 Hz and above 16 KHz. However, the BANDWIDTH control can further narrow the audio bandwidth. See Section 3.14 for operating instructions.

There is no internal calibrator for the modulation functions. An external sine wave modulated signal of known modulation percentage can be used to calibrate the percent scale if absolute measurements are desired. A fixed carrier level as indicated in the CARR position must be maintained to obtain meaningful percent readings. The AUDIO control adjusts the gain of the metering circuit.

3.11.7 FM MODULATION. The FM MODULATION position permits metering the output of the built-in discriminator. The metering detector is AC-coupled with 3 DB-down frequency response points below 20 Hz and above 16 KHz. Its gain is set with the AUDIO control and output is read on the meter's percent scale.

Because percent modulation has no general meaning for FM or PM signals, calibration must be performed using a signal of known deviation. Full limiting is achieved with any signal that indicates on the upper meter scale in the CARR position. The signal should be carefully tuned for maximum meter indication in the CARR position and the proper IF BANDWIDTH used or severe phase distortion can occur. AFC may be used to "hold" drifting signals, as outlined in Section 3.12.

3.12 AFC OPERATION

Accurate CARR, AM and FM MODULATION measurements of drifting signals can be made if the AFC circuit is used. To properly use the AFC:

a) Set controls:
DETECTOR FUNCTION - CARR.
BANDWIDTH - As desired
TUNING MODE - MAN.

b) Using the TUNING and FINE TUNING controls, tune the signal for maximum meter indication.

c) Turn the TUNING MODE switch to AFC and repeak the signal with the FINE TUNE control.

3.13 TUNING AID OPERATION

Location of extremely weak signals is enhanced by use of the TUNING AID. With the TUNING AID on, a "beat note" will be heard when tuning past a signal. The TUNING AID switch should be off (down) while making all quantitative measurements, or serious inaccuracies will result.

3.14 BANDWIDTH CONTROL

A variation of at least 6:1 in 3 DB CW bandwidth is selectable with the BANDWIDTH control. The available bandwidths, which vary with the band in use, are shown in Section 1.3.

Maximum CW sensitivity is obtained in the NARROW bandwidth, but if it is desired to recover the signal's modulation the bandwidth should be chosen carefully, consistent with the width of modulation.

Maximum impulse sensitivity is obtained in the WIDE bandwidth, for which all calibration curves are given. Determination of whether a signal is broadband or narrowband can be made by setting the Detector Function switch to Peak, the Bandwidth to WIDE and tuning in the signal. Note the meter indication and switch to NARROW. Compare the drop in meter indication with that noted when switching from WIDE to NARROW using the internal impulse generator (see paragraph 3.7.3 for control settings). If the drop on the external signal is less than that using the impulse generator, by a margin of at least 2 DB, the signal is narrow compared to the wide bandwidth of the EMC-25 and cannot be accurately measured in terms of DB/uV/KHz (or MHz).

3.15 CONNECTOR FUNCTIONS - FRONT PANEL

3.15.1 RF INPUT. The nominal 50-ohm input terminal to which the signal to be measured is applied.

3.15.2 IG OUTPUT. The output terminal of the impulse generator.

3.15.3 PHONES. The terminal for 600 ohm or higher impedance earphones.

3.15.4 AM VIDEO. A nominal 91-ohm output terminal for DC-coupled, logged, signal amplitude video information.

3.15.5 FM VIDEO. A nominal 91-ohm output terminal for DC-coupled, instantaneous FM deviation video information.

3.15.6 REMOTE CONNECTOR. The interface connector for all system remote control functions.

3.16 CONNECTOR FUNCTIONS - REAR PANEL (See Figure 3.5)

3.16.1 PRE-IF OUTPUT. Provides a linear signal at one of the three IF frequencies depending upon the band in use. Impedance is nominally 50 ohms. Voltage level and bandwidth depend on the band in use. This output should be capped when unused and terminated in 50 ohms during use.

3.16.2 POST-IF OUTPUT. Provides a linear signal at the IF frequency and selected bandwidth determined by the band in use and position of the BANDWIDTH switch. 1 MV is available at 8.7 MHz and 3 MV at 175 KHz and 1.6 MHz for full scale meter reflection. This output should be capped when unused and terminated in 50 ohms when in use.

3.16.3 POWER INPUT. Either AC power or an external battery may be connected here, to charge or supplement the internal battery.

3.17 BATTERY OPERATION

To operate the EMC-25 on internal battery, turn on the POWER switch. Immediately turn the DETECTOR FUNCTION switch to BAT. Observe the indicator, if the BAT TEST light glows, then the instrument may be put into use. Never leave the POWER switch on for more than a few seconds, if the light does not glow, or the battery may be damaged. It is advisable to check the battery condition periodically during extended use.

A fully charged battery will operate the EMC-25 for at least eight hours. Use of the band-stepping motor in the EMC-25R will shorten the operating cycle moderately, the exact amount depending on the duty cycle of its use. The instrument should not be stored with a discharged battery longer than one week. During long storage periods, the battery should be brought to full charge at least once every six months.

3.17.1 CHARGING THE BATTERY. The internal battery is charged any time the instrument is connected to an AC line. It takes approximately 16 hours to fully charge a completely discharged battery.

To charge the battery, set the line voltage switch on the rear panel to the appropriate position, change the adjacent fuse to the correct value if necessary and connect the line cord

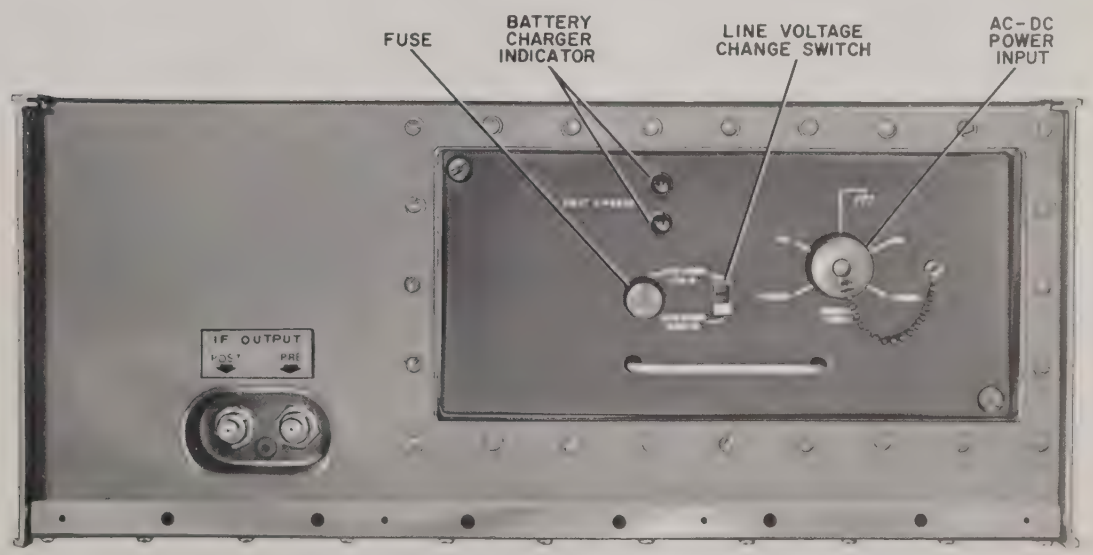


Figure 3.5 Connector Functions, Rear Panel

PDA-25. The two pilot lights will glow, indicating that the charger is operating. The POWER switch should be left off to obtain the maximum charge rate.

3.18 LINE OPERATION

To operate the instrument from an AC line adjust the line voltage switch and fuse as outlined in paragraph 3.17.1 before connecting the PDA-25 line cord, then turn the POWER switch on and immediately check the battery charge. Do not leave the POWER switch on if the BAT TEST light does not glow. The battery must first be charged as described in paragraph 3.17.1, despite the AC power source.

3.19 EXTERNAL BATTERY

Battery operation for periods longer than 8 hours may be accomplished by using external storage batteries in conjunction with power cord PDD-25. To operate, connect an external floating battery of 30 to 56 volts utilizing the PDD-25. The red clip should be connected to the positive battery terminal. Turn on the POWER switch and check the battery as outlined in 3.17. The same precautions apply. The instrument will only draw power from the external battery (as indicated by the charge lights) if the external battery is more than 6.5 volts higher than the internal battery.

A	Tuning Pot Arm
B	Sweep In
C	Tuning Voltage Input (0 to +1.5 v nominal)
D	Sweep Out
E	8-Band Logic
F	2-Band Logic
H	16-Band Logic
J	4-Band Logic
K	AFC
L	BW Selector Out
M	Band Logic Comm.
N	BW Command (+12 v = N.B. -6 v = W.B.)
P	NO X-Y Recorder Pen Lift
R	Y Out (1 ma. 1500 ohms)
S	NC X-Y Recorder Pen Lift
T	Comm. X-Y Recorder Pen Lift
U	Audio Output
V	X Out (0 to +1.5 v)
W	Step Command (0 = OFF + 12 v = STEP)
X	Shunt Cal Command (- Raw Activate)
Y	IG Contacts (-300 v to +300 v for external level)
Z	IG Driver Command (-6 v)
AA	Gain (0 to +12 v)
BB	Dump Command
CC	Ground
DD	HV Raw
EE	+12 v Command Functions Only
FF	Ground
HH	Internal IG Level Switch
JJ	-6 v Command Functions Only
KK	+Raw Command Functions Only
LL	Spare
MM	Spare
NN	-Raw Command Functions Only

Figure 3.6 Remote Connector (Outside View)

TABLE 3-1

REMOTE FUNCTIONS

FIGURE	FUNCTION
3.7	Connections necessary for manual operation
3.8	Connections necessary for X-Y recorder monitoring
3.9	Connections necessary for audio monitoring
3.10	Connections necessary for remote tuning
3.11	Connections necessary for remote gain control
3.12	Connections necessary for remote dump operation
3.13	Connections necessary for external meter/recorder monitoring
3.14	Connections necessary for remote bandwidth operation
3.15	Connections necessary for remote external sweep control
3.16	Connections necessary for remote tuning meter monitoring and AFC control

3.20 REMOTE OPERATION

3.20.1 PROGRAMMING. Remote programming of the EMC-25 is achieved through the REMOTE connector by either voltage or resistance control. Figure 3.6 illustrates the REMOTE connector with the lettering corresponding to each input and the legend denotes each pin function. Figure 3.7 shows the connections necessary to the dummy connector for manual operation. Figures 3.8 through 3.16 show connections necessary for remote programming of various functions that may be desirable depending on the test setup used. Table 3-1 lists each hookup, relates it to the proper figure and gives its function. Appropriate notes are contained in each figure.

3.21 X-Y PLOTTING

3.21.1 GENERAL. With the addition of an X-Y recorder such as Electro-Metrics Model EXY-125, the internal sweep circuit can be used to make semi-automatic measurements.

3.21.2 INTERNAL SWEEP. The EMC-25 is equipped with an internal one-minute linear sweep circuit. It is energized by switching the Tuning Mode switch to SWEEP and is reset to the low frequency end of the band in use by depressing the START push button. As it sweeps the EMC-25 from the low to the high frequency end of the band in use, a 0 to 1.5 volt sweep voltage simultaneously appears at the Remote Connector for attachment to the X axis of an X-Y recorder. This sweep mode is generally

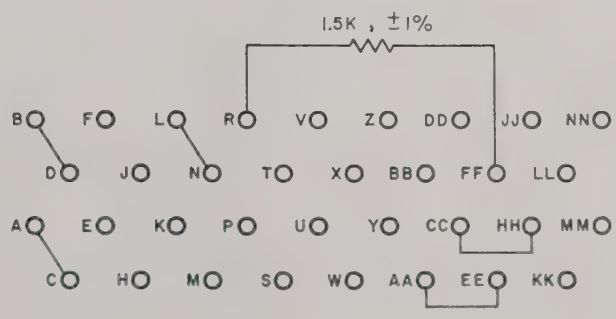


Figure 3.7 Remote Connector (Manual Operation)

used with the EXY-125 recorder and its accompanying cable XYC-25. A connection diagram for other recorders is shown in Figure 4.1.

The internal sweep requires the use of the detector mode switch in PEAK and the DUMP control "on", but as far counter-clockwise as it can be turned without "clicking" the detent off. Calibration is accomplished as follows:

a) Tune to the approximate arithmetic center of the band in use.

b) Use the manual calibration procedure of paragraph 3.6 at the frequency chosen in a.

c) Switch the Tuning Mode selector to SWEEP.

d) Depress the START button and adjust the recorder X-ZERO to align the pen with the left paper margin.

e) Release the START button and allow the recorder to sweep until it stops. Then adjust the recorder X-GAIN to align the pen with the right paper margin.

f) Remove the remote connector temporarily to adjust the recorder Y-ZERO control to align the pen with the bottom paper margin.

g) Replacing the connector, depress the SHUNT CAL button and adjust the recorder Y-GAIN so that the pen is aligned with the horizontal graph line whose value agrees with the meter reading.

h) Depress the START button then the SHUNT CAL button. Holding the SHUNT CAL button, release the START button and permit the recorder to complete a full band sweep. The recorder plot is one of constant impulse sensitivity. CW sensitivity can be deduced from the chart given for the band in use. (The EMC-25 was calibrated in steps a. and b.) Impulse calibration correction can be assumed constant across the band and can be deduced from the correction required at the calibration frequency.

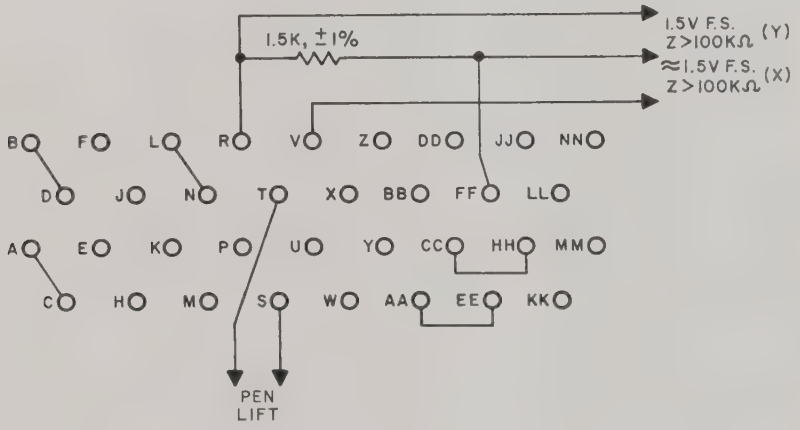


Figure 3.8 X-Y Recorder - Remote Connections

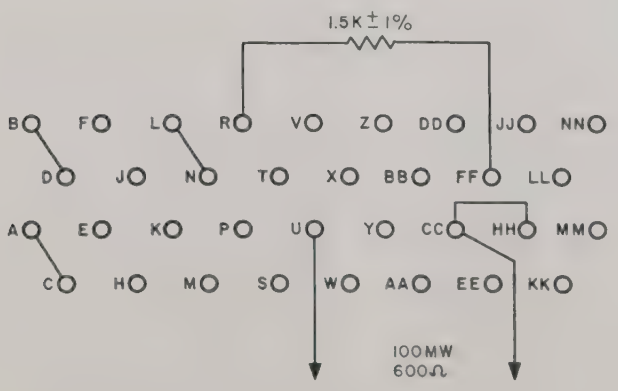


Figure 3.9 Audio - Remote Connections

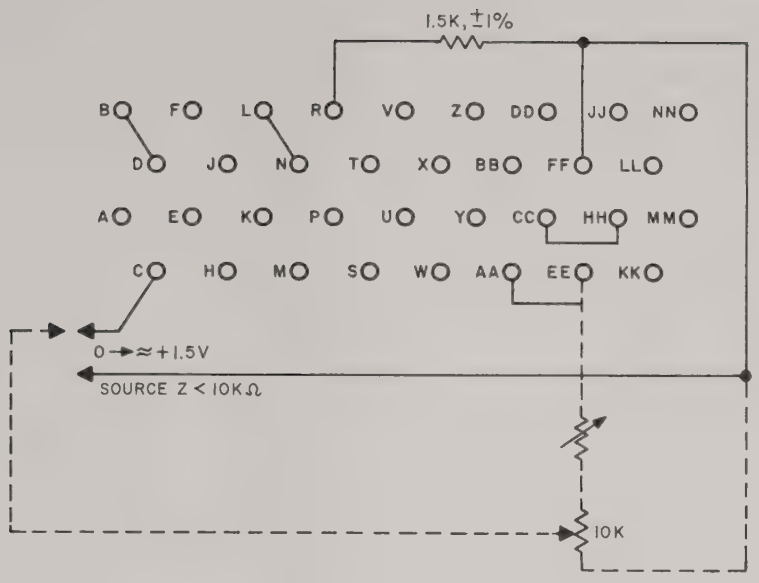


Figure 3.10 Tuning - Remote Connections

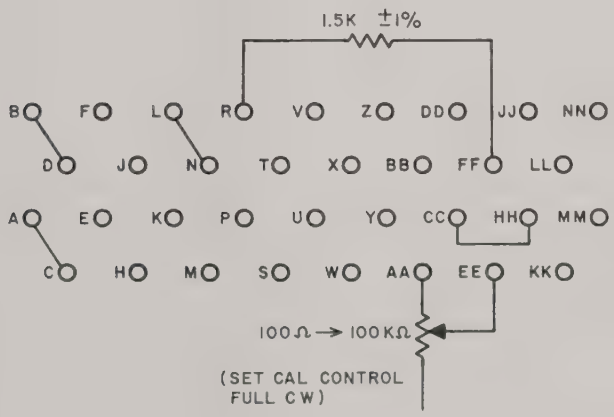


Figure 3.11 Gain - Remote Connections

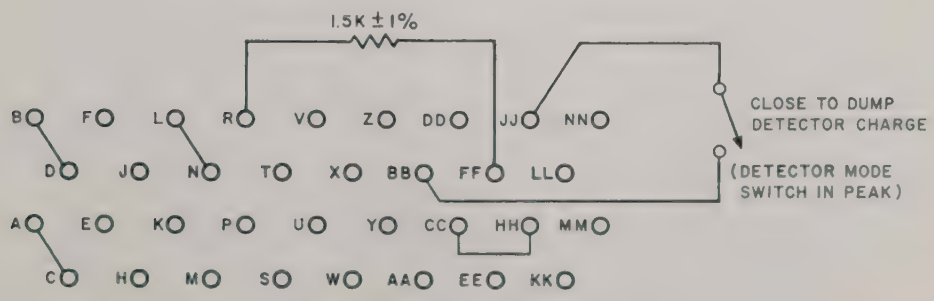


Figure 3.12 Dump - Remote Connections

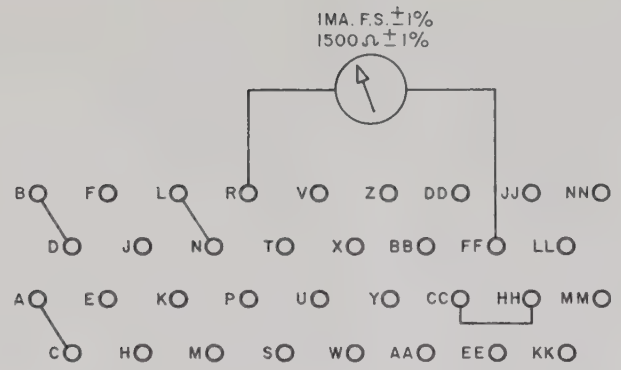


Figure 3.13 External Meter/Recorder - Remote Connections

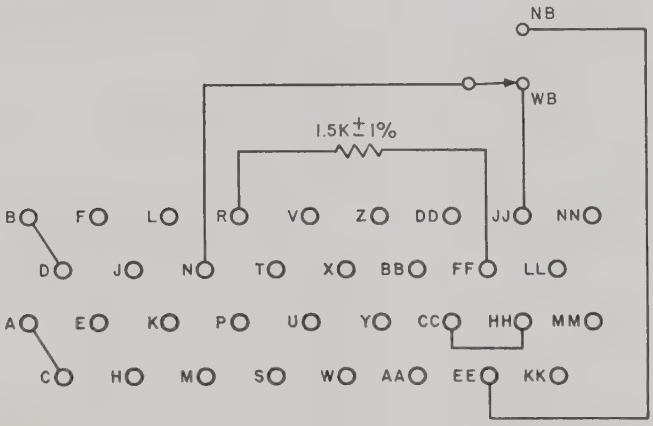
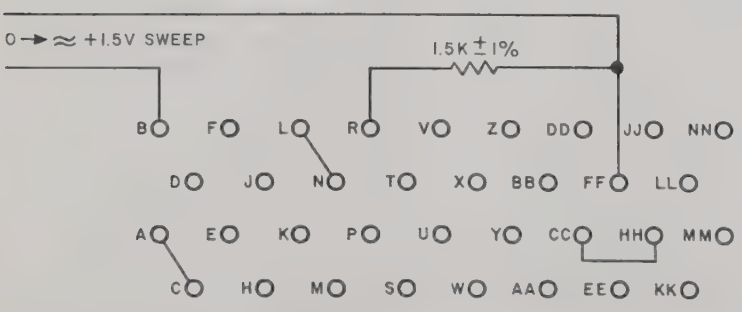


Figure 3.14 Bandwidth - Remote Connections



EXTERNAL SWEEP WILL BE ACTIVATED ONLY WHEN THE TUNING MODE SWITCH IS SET TO SWEEP. FOR MANUAL OPERATION, SET SWITCH TO MANUAL.

Figure 3.15 Manual Tune-External Sweep - Remote Connections

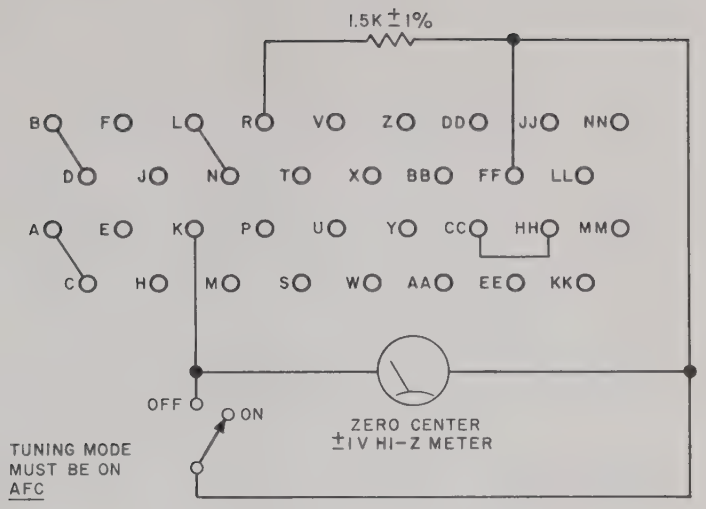


Figure 3.16 Tuning Meter/AFC Control - Remote Connections

SECTION IV
SERVICE AND MAINTENANCE

4.1 GENERAL

4.1.1 This section includes material necessary for the maintenance and repair of the Interference Analyzer EMC-25. Repair of as complex an instrument as the EMC-25 should only be attempted by an individual well acquainted with its intricacies and thoroughly familiar with EMC measurement techniques.

CAUTION

Readjustment of almost any internal control can invalidate all calibrations performed at time of assembly. Only the battery and audio amplifier are replaceable without recalibration.

4.1.2 This instrument contains a nickel-cadmium battery which, when fully charged, can power the instrument without connection to an external AC or DC supply for approximately eight hours. Operation of all circuits in this instrument is highly dependent on the regulation of the power supply voltage. For most efficient operation, connection should be made to a live 110 V AC receptacle, whether turned OFF or ON, and kept on charge even when in storage. It cannot be overcharged. Since most testing with this instrument is usually performed sporadically for short periods of time, it is difficult to know the actual charge conditions of the battery. The front panel BAT TEST switch indicates that the instrument can be operated; it does not imply any duration of proper operation. Battery test legend on the front panel meter has been superseded by the battery test light. Before performing any service or maintenance on this instrument, consult Section 4.3.2, Power Supply.

4.2 REPLACEMENT OF ASSEMBLIES

4.2.1 Access to this instrument should be attempted only by qualified personnel, and then only for the purpose of a power supply check or for interchanging one of the individual plug-in circuit modules. Repair of individual modules should be done only at the factory on an exchange or repair basis. Actual access to this instrument is gained by removal of the bottom panel. This is accomplished by removal of holding screws around the outside edge.

4.2.2 Reference to Figure 4.1 will show the location of each of the assemblies by name and nomenclature. Power supply check should be completed prior to removal of any assembly. All assemblies are coupled by means of shielded cables and held firmly in place with brackets and quarter-turn fasteners. Removal of an assembly may be accomplished by carefully removing the brackets and fasteners that may be physically holding the assembly in place. All connectors must be carefully removed. Care must be taken that each connector is properly identified to insure correct connection is made later. Clamps that are securing cable harness to case may require loosening or removal to facilitate assembly removal. Suspected assembly should now be removed, exercising extreme care not to disturb adjoining assemblies, or damaging connecting cables to these assemblies.

4.3 PERIODIC SERVICE

4.3.1 Most malfunctions in this instrument can be traced to power supply failure or improper operation. All service and maintenance should begin with a check of both battery and regulated voltages. It is recommended that the instrument be turned OFF and connected to the AC line for at least 16 hours prior to servicing to fully charge the battery.

4.3.2 POWER SUPPLY. Before opening the instrument, remove the dummy plug on the front panel REMOTE connector (see Figure 3.3). Measure the voltages at the REMOTE connector with the EMC-25 turned on. Refer to Figure 3.6 for the REMOTE connector pin numbering and for corresponding functions at the REMOTE connector. Test points and correct voltages for troubleshooting assistance are shown in Table 4-1.

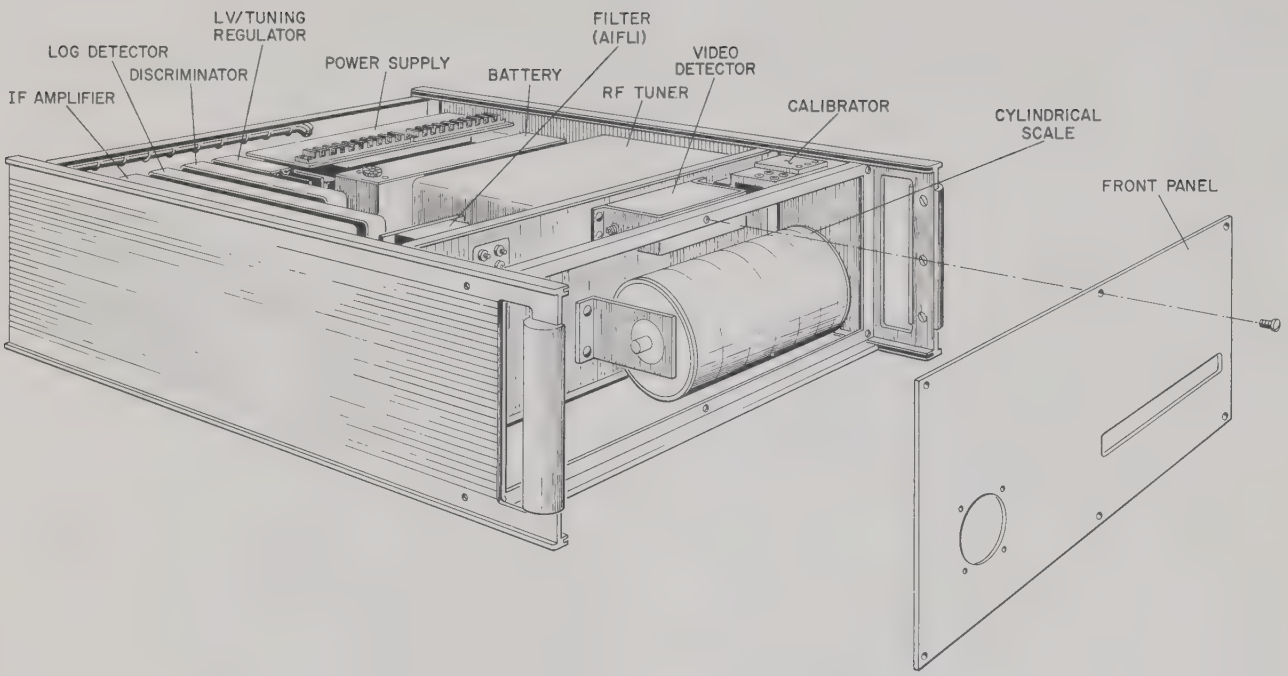


Figure 4.1 Replaceable Assembly Locations (Bottom View)

TABLE 4-1

POWER SUPPLY TEST VOLTAGES

PIN	VOLTAGE
CC	GROUND (Reference for other readings)
DD	+110 V Min
EE	+11.90 to +12.10 V
JJ	-5.90 V to -6.10 V
KK	+15 V Min
NN	-9 V Min

4.4 REPLACEABLE ASSEMBLIES

4.4.1 In the event subassembly replacement has been authorized, it may be removed from the equipment and returned separately to the factory. This will eliminate the necessity of repackaging and shipping the entire instrument. Refer to Table 4-2 for name and nomenclature of replaceable assemblies.

TABLE 4-2

REPLACEABLE ASSEMBLIES

NAME	NOMENCLATURE	LOCATION
RF-Tuner (includes removable band strips)	A2	Figure 4.1
IF Amplifier	A3	
Log Detector	A4	Figure 4.1
Discriminator	A8	Figure 4.1
Video Detector	A1A1	Figure 4.1
Power Supply	A5	Figure 4.1
Low Voltage Regulator	A5P3	Figure 4.1
Control Section	A1A6	Figure 4.1
Battery	A7	

SECTION V
ACCESSORY DATA

5.1 GENERAL

5.1.1 This section contains information describing available accessory items designed specifically for operation with the EMC-25 Interference Analyzer. All of these items are listed in Table 5-1.

TABLE 5-1

ACCESSORY LIST

ITEM	DESCRIPTION	MODEL
1	Interference Analyzer (including Battery Pack Model BAT-25, AC Power Cord Model PCD-25, instruction manual, alignment tools, Adapter Brackets Model ABM-25, certificate of performance) 14 KHz to 1000 MHz	EMC-25
2	Interference Analyzer, as above, but also including built-in stepping motor for remote positioning of turret, 14 KHz to 1000 MHz	EMC-25R
3	Instrument Carrying Case	ICC-25
4	Remotely Switchable Loop Antenna, 14 KHz to 25 MHz	ALR-25
5	Remote Active Vertical 41" Antenna, 14 KHz to 25 MHz with Carrying Case	RVA-25
6	Remotely Switchable Vertical 41" Antenna, 14 KHz to 25 MHz	RVR-25
7	Broadband Dipole Antenna and Mount, 20 MHz to 200 MHz	BDA-25
8	Low Frequency Antenna Accessory Case (For transporting loop antenna, 41" Remote Antenna, Broadband Dipole and small accessories)	LVC-25
9	Log Conical Spiral Antenna, 200 MHz to 1000 MHz	LCA-25
10	Conical Antenna Carrying Case (For transporting LCA-25)	LCC-25
11	Clamp-on Probe, 14 KHz to 110 MHz (For maximum sensitivity 14 KHz to 11.5 MHz use PCL-10)	PCL-25
12	Magnetic Field Probe, 14 KHz to 520 KHz	MFA-25
13	Magnetic Field Probe, 480 KHz to 25 MHz	MFB-25
14	Magnetic Field Probe, 22 MHz to 230 MHz	MFC-25
15	Electro-Static Field Probe, 14 KHz to 1000 MHz	EFP-25
16	Counterpoise, 2' x 2' (for vertical antennas)	GPA-25

TABLE 5-1 (Cont'd.)

ITEM	DESCRIPTION	MODEL
17	Carrying Cover with Handle	EAC-25
18	Earphones, speech	EEM-25
19	Earphones, high intelligibility	EHF-25
20	Attenuator, Voltage Extension (20 DB, 4 watts)	FA-504-20T
21	Remote Meter with 25 ft. cable	RIM-25
22	Coaxial Cable, 25 foot	CAC-25
23	Extra Adapter Brackets (pr. for 19" rack mounting)	ABM-25
24	Extra Alignment Tool Kit	ATK-25
25	Extra AC Power Cord	PCD-25
26	DC Power Cord	PDD-25
27	Tripod (Rugged) and Tripod Bag	TRP-25
28	Mast Sections (2)	MSA-25
29	Replacement Nickel Cadmium Battery Pack	BAT-25
30	Extra Instruction Manual	--
31	Tunable Rejection Filters	
	14 KHz - 220 KHz	TRF-11
	220 KHz - 3500 KHz	TRF-12
	3.5 MHz - 14 MHz	TRF-13
	14 MHz - 110 MHz	TRF-14
	110 MHz - 1000 MHz	TRF-15
32	Complete Set, Tunable Rejection Filters, 14 KHz - 1000 MHz	as above
33	Instrument Carrying Case (For one TRF filter)	ICC-15
34	Standard Accessory Kit, 14 KHz - 1000 MHz, consisting of:	AAK-25A
	(1) Remotely Switchable Loop Antenna, 14 KHz - 25 MHz	ALR-25
	(2) Remotely Switchable Vertical 41" Antenna, 14 KHz - 25 MHz	RVR-25
	(3) Antenna Accessory Case	LVC-25
	(4) Broadband Dipole Antenna and Mount, 20 MHz - 200 MHz	BDA-25
	(5) Log Conical Spiral Antenna, 200 MHz to 1000 MHz	LCA-25
	(6) Conical Spiral Antenna Accessory Case	LCC-25
	(7) Coaxial Cable, 25 ft.	CAC-25
	(8) Clamp-on Probe, 14 KHz - 110 MHz	PCL-25
	(9) Magnetic Field Probe, 14 KHz - 520 KHz	MFA-25
	(10) Magnetic Field Probe, 480 KHz - 25 MHz	MFB-25
	(11) Magnetic Field Probe, 22 MHz - 230 MHz	MFC-25
	(12) Electro-Static Field Probe, 14 KHz to 1000 MHz	EFP-25
	(13) Tripod	TRP-25
	(14) Tripod Bag	TRB-25
	(15) Counterpoise, 2' x 2'	GPA-25

TABLE 5-1 (Cont'd.)

ITEM	DESCRIPTION	MODEL
35	Electro-Scan Programmer for EMC-25R and EMC-10 with Antenna Switching Unit SU-125	ESC-125A
36	11" x 17" X-Y Plotter with choice of inter-connecting cable XYC-10 to EMC-10 or ESC-10A, or XYC-25 to EMC-25 or ESC-125A	EXY-125A
37	11" x 17" Dual-Pen X-Y Plotter with interconnecting cable XYC-35 to ESC-125A	EXY-250
38	Spectrum Analyzer Adapter including Oscilloscope, Time Base Plug-In and Plug-In Model PP-125	SPA-125
39	Spectrum Analyzer Plug-In (Plug-In Only)	PP-125
40	Extra X-Y Plotter Interconnecting Cable to EMC-25, EMC-25R, or ESC-125A	XYC-25
41	Automated Spectrum Surveillance System including EMC-10, EMC-25R, or ESC-125A, EXY-125A and SPA-125 mounted together in 2-bay console, interconnected and tested as a system	FSS-250
42	Automated Spectrum Surveillance System including EMC-10, EMC-25R, ESC-125A, EXY-250 and SPA-125 mounted together in 2-bay console, interconnected and tested as a system	FSS-250D

SECTION VI
REFERENCE DATA

6.1 GENERAL

6.1.1 This section contains information which will be helpful in signal tracing during instrument checkout and/or maintenance. Figure 6.1 is a schematic location guide followed by electrical drawings. These electrical drawings are presented, as near as possible, in the order of signal flow within the instrument.

6.1.2 As an example, to locate the schematic of the log detector, check the lower right-hand corner of the block titled log detector for the figure number (Figure 6.11).

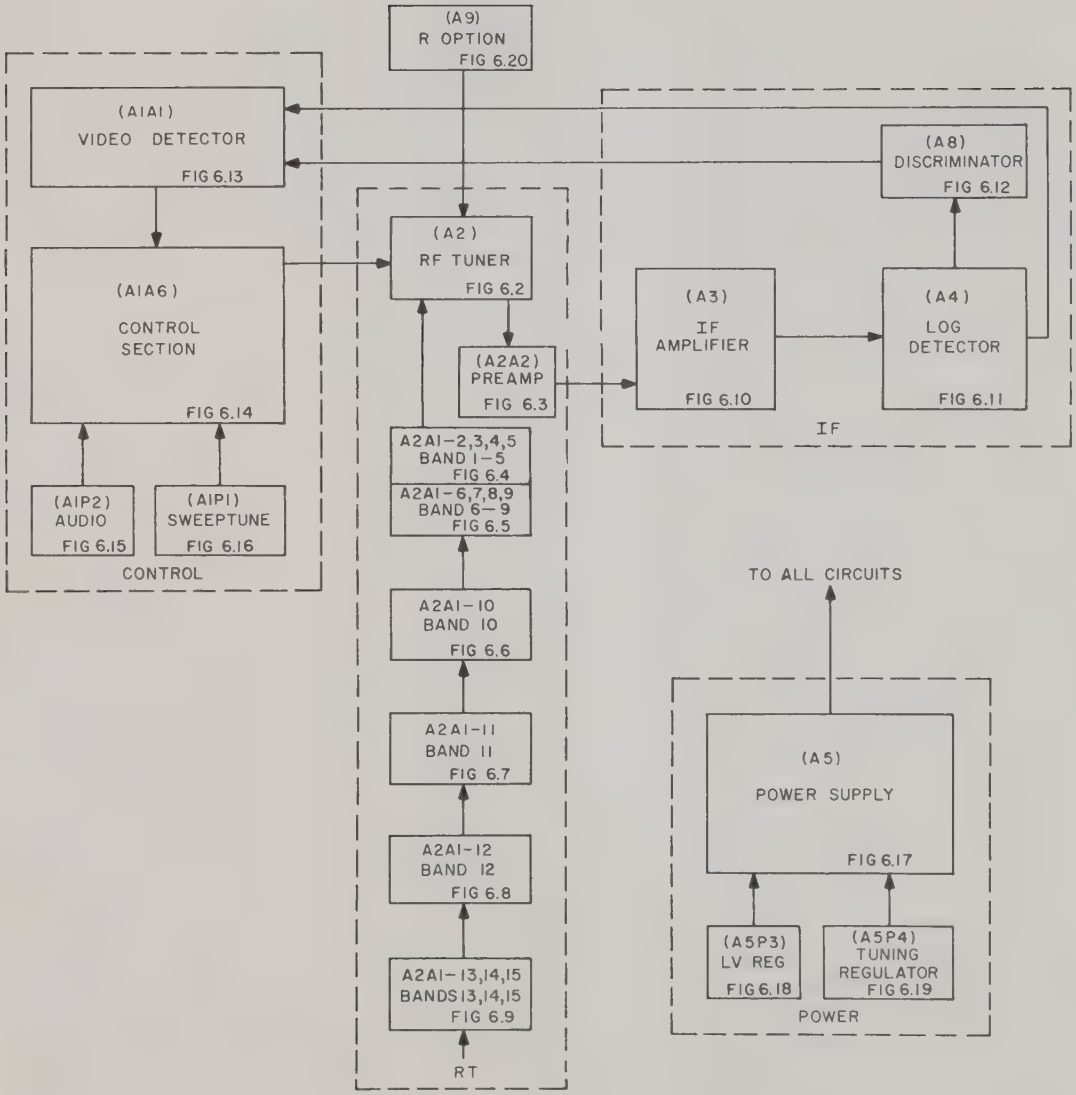
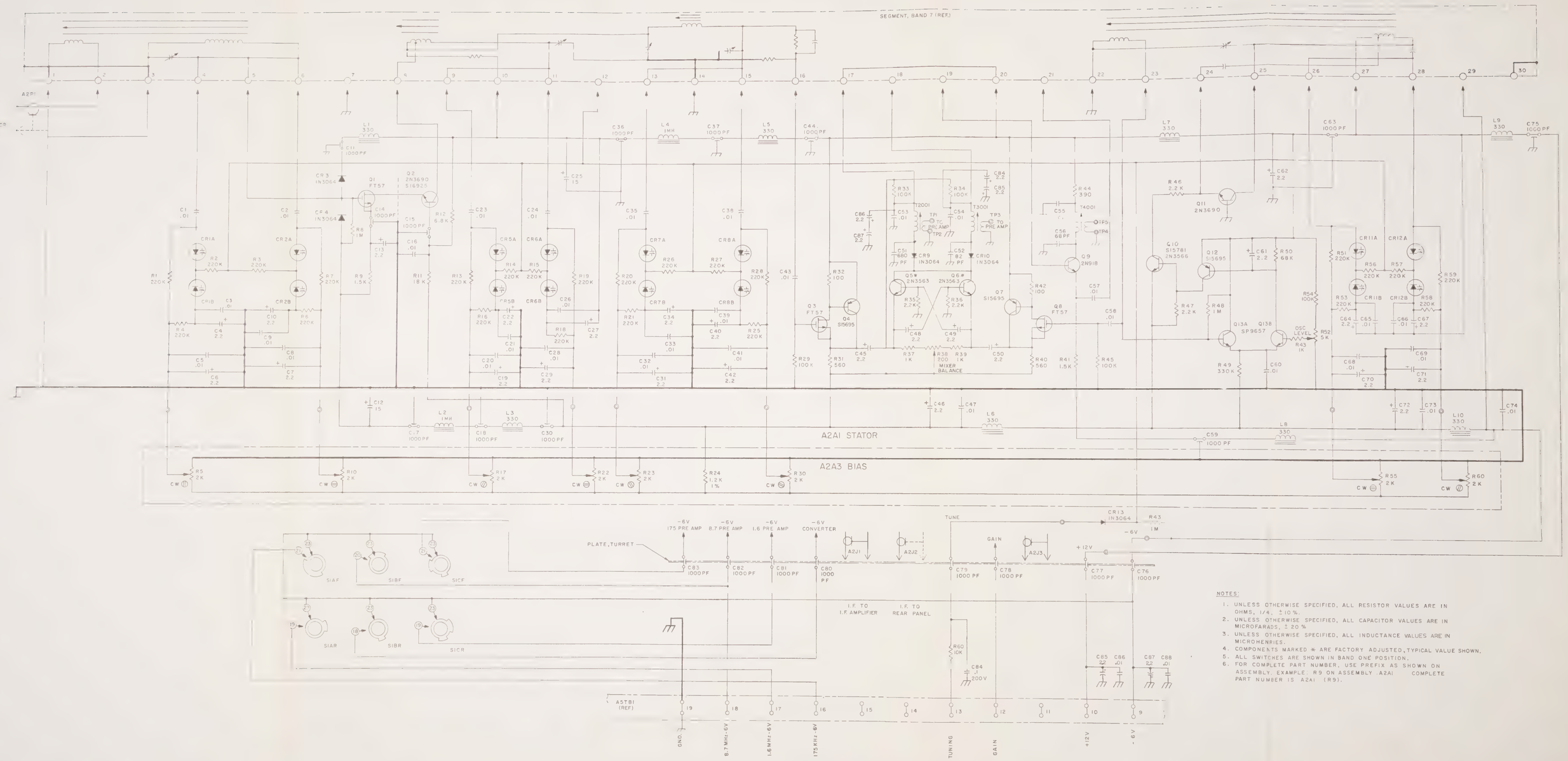


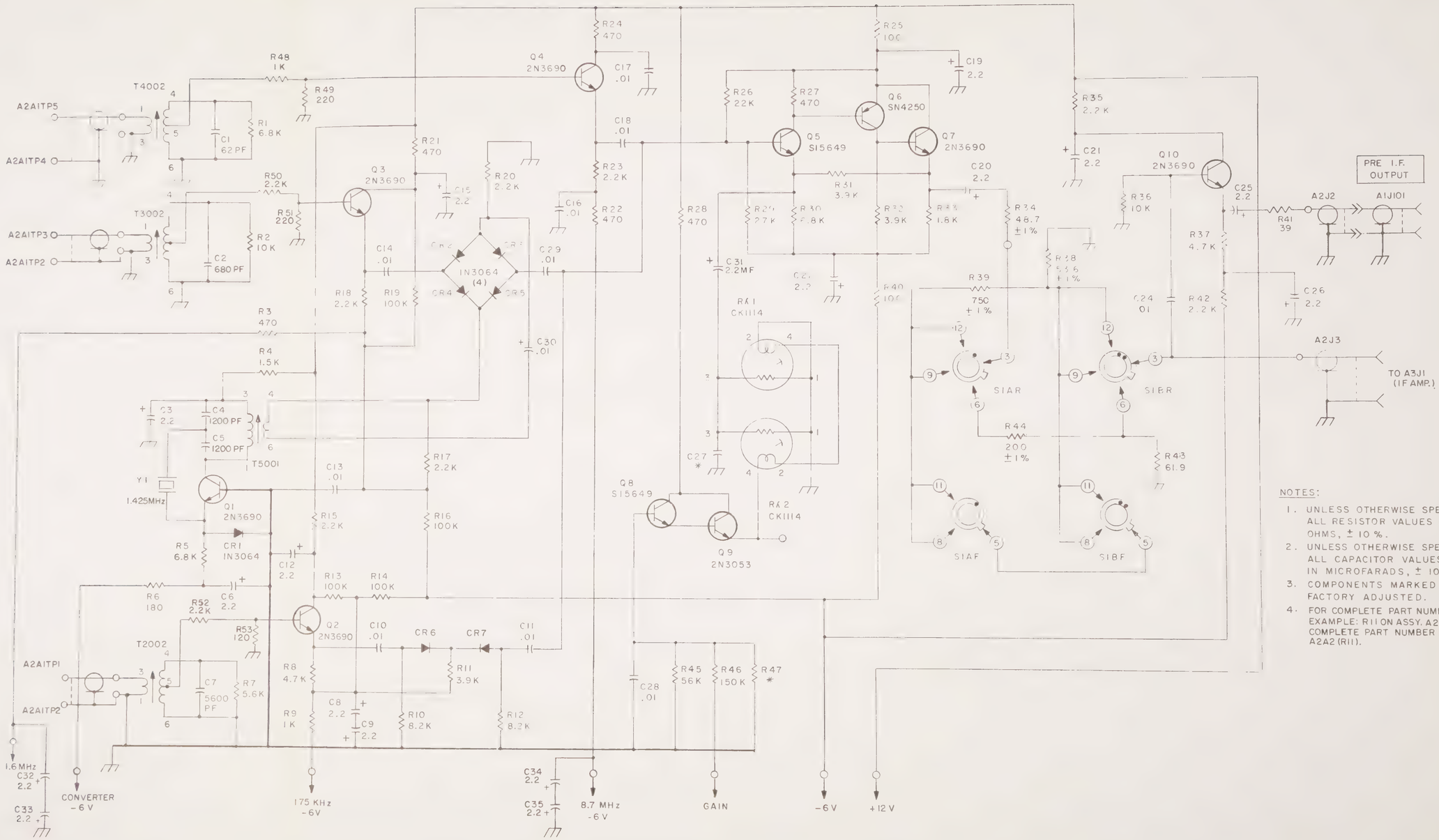
Figure 6.1 Schematic Location Guide



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4, ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20 %
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUE SHOWN.
5. ALL SWITCHES ARE SHOWN IN BAND ONE POSITION.
6. FOR COMPLETE PART NUMBER, USE PREFIX AS SHOWN ON ASSEMBLY. EXAMPLE: R9 ON ASSEMBLY A2A1 COMPLETE PART NUMBER IS A2A1 (R9).

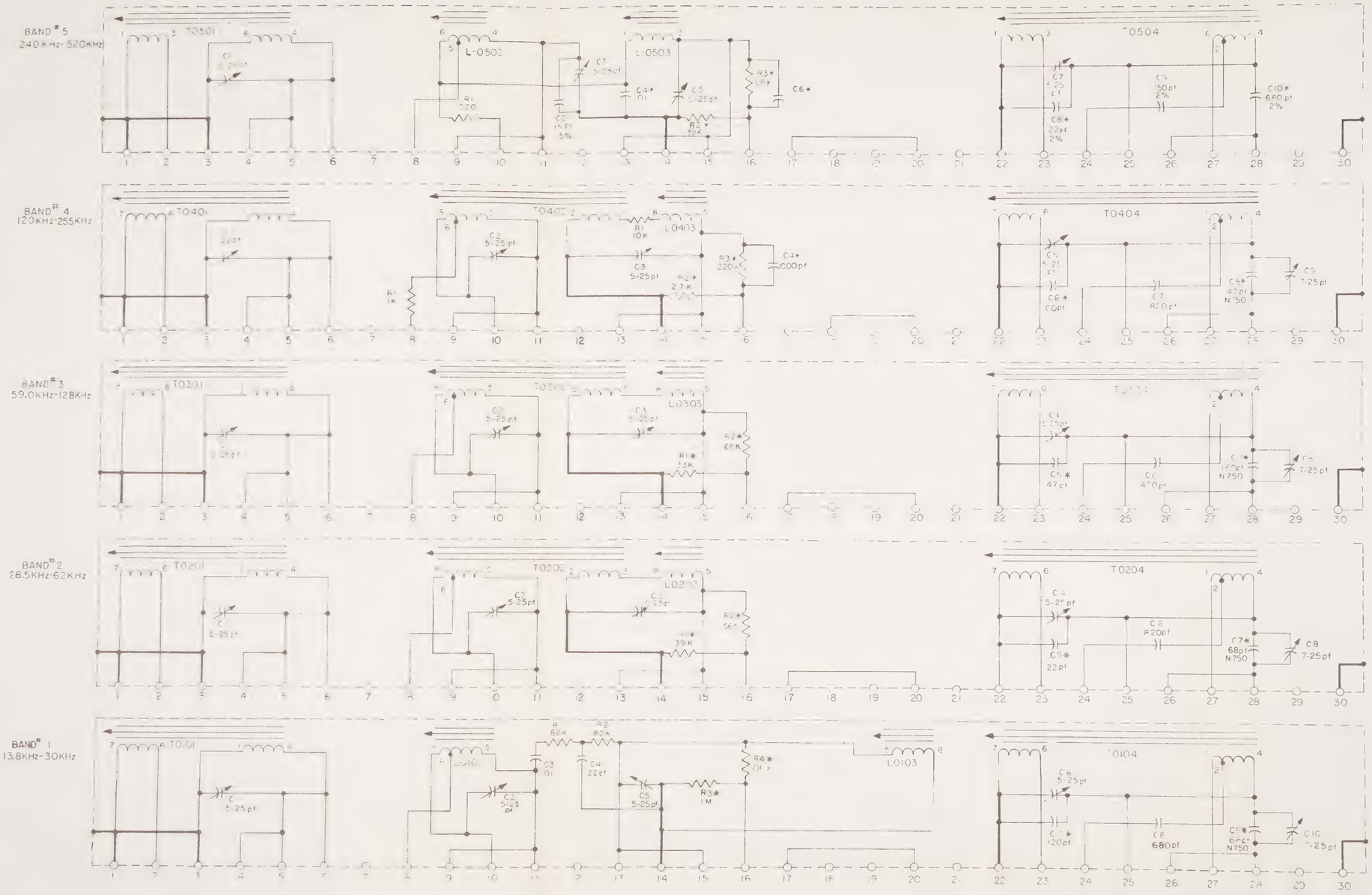
Figure 6.2 RF Tuner (A2), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, ± 10 %.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10 %.
3. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
4. FOR COMPLETE PART NUMBER, EXAMPLE: R11 ON ASSY. A2A2 COMPLETE PART NUMBER IS A2A2(R11).

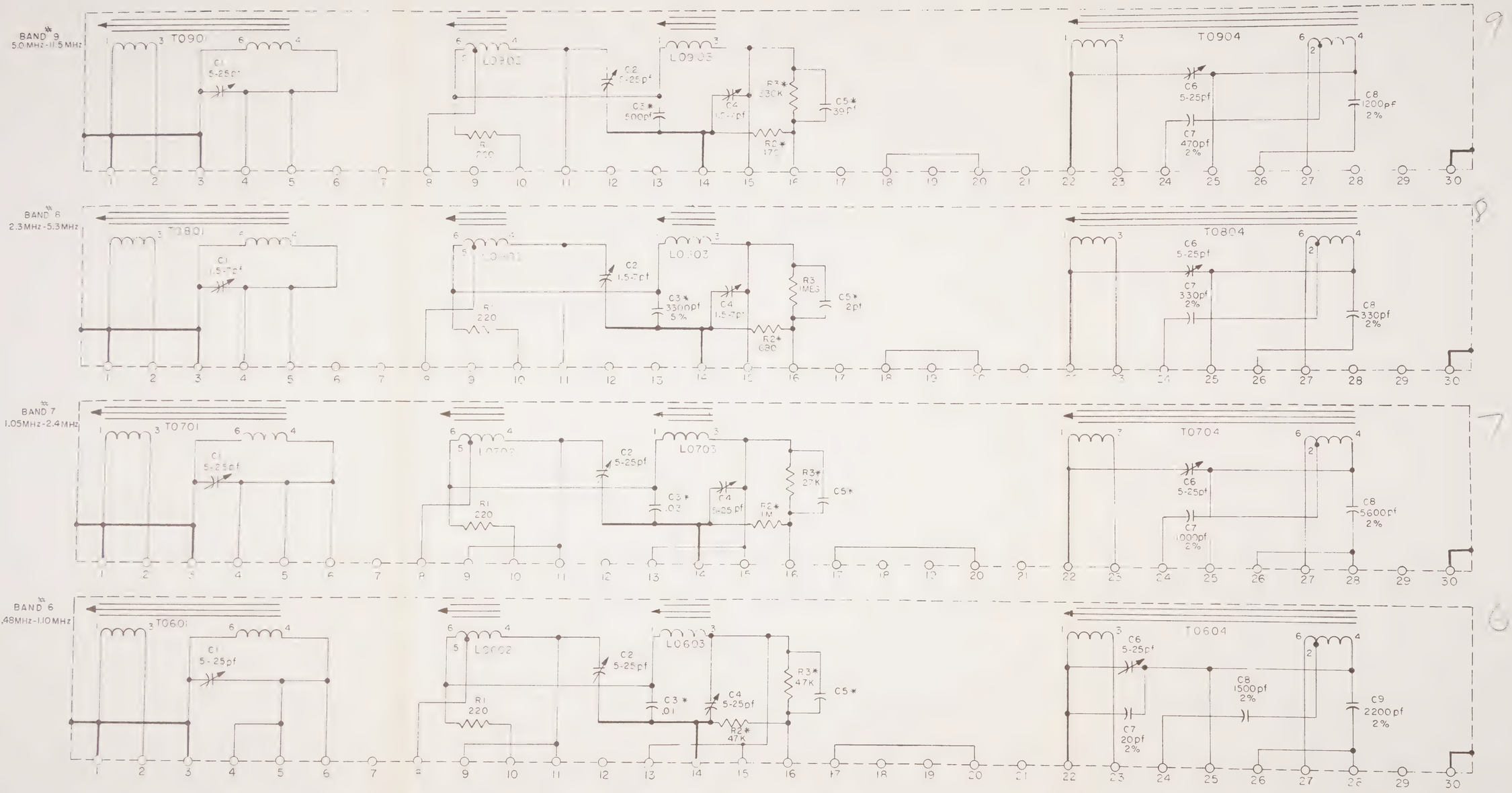
Figure 6.3 Preamp (A2A2), Schematic Diagram



NOTES:

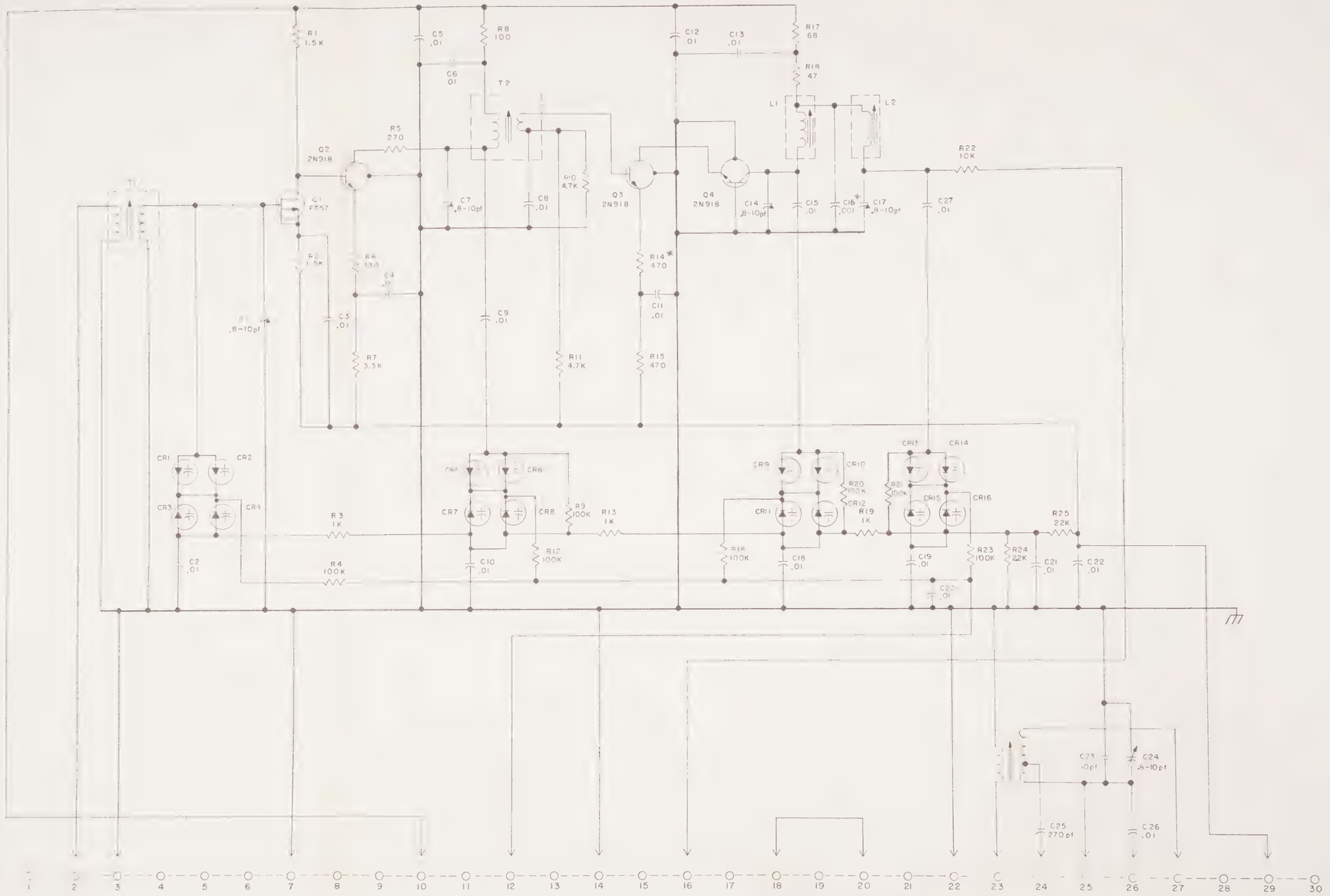
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED. TYP VALUES SHOWN.

Figure 6.4 Band 1-5 (A2A1-2, 3, 4, 5), Schematic Diagram



NOTES: (SEE SHEET 1)

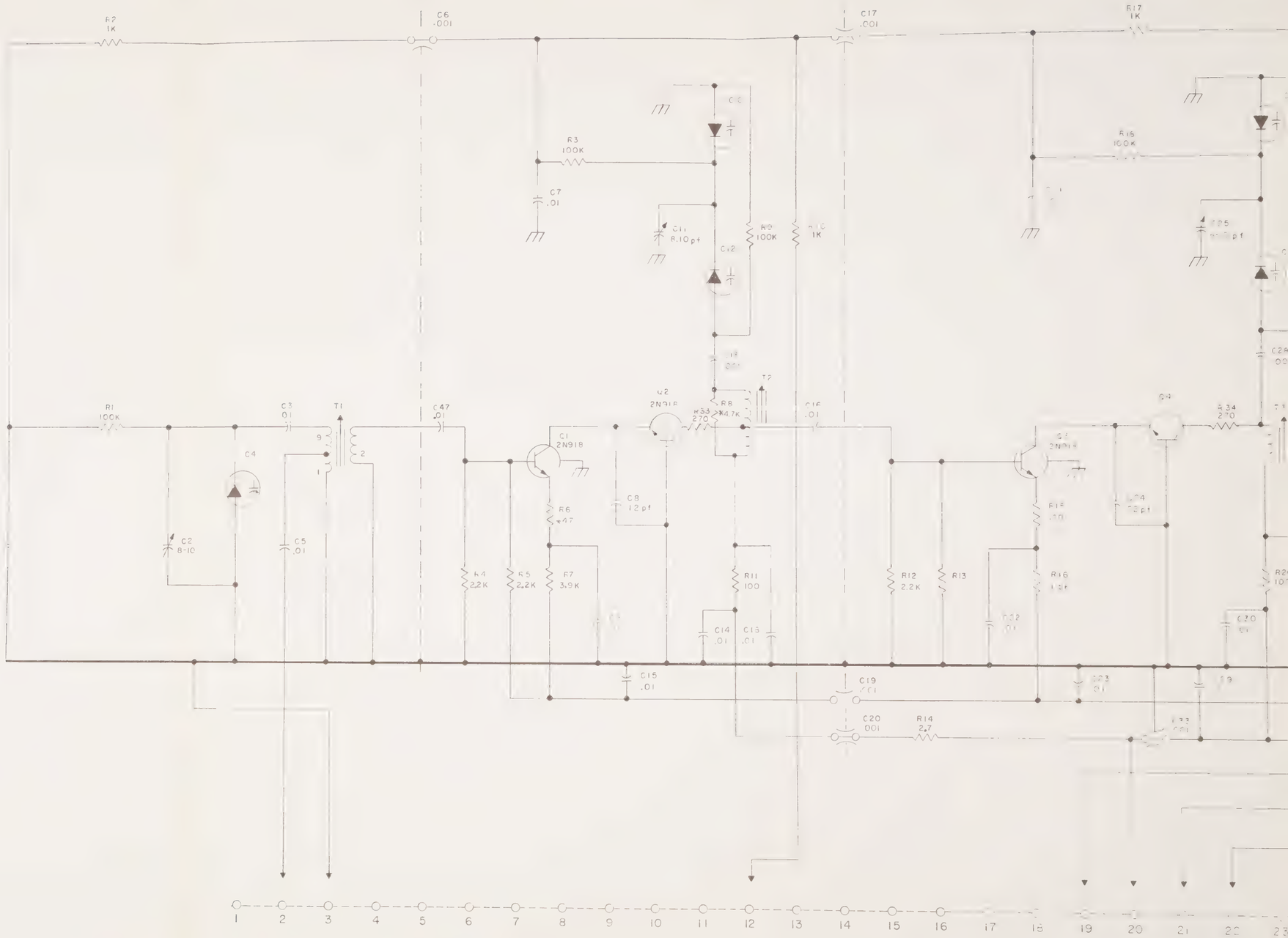
Figure 6.5 Band 6-9 (A2A1-6, 7, 8, 9), Schematic Diagram

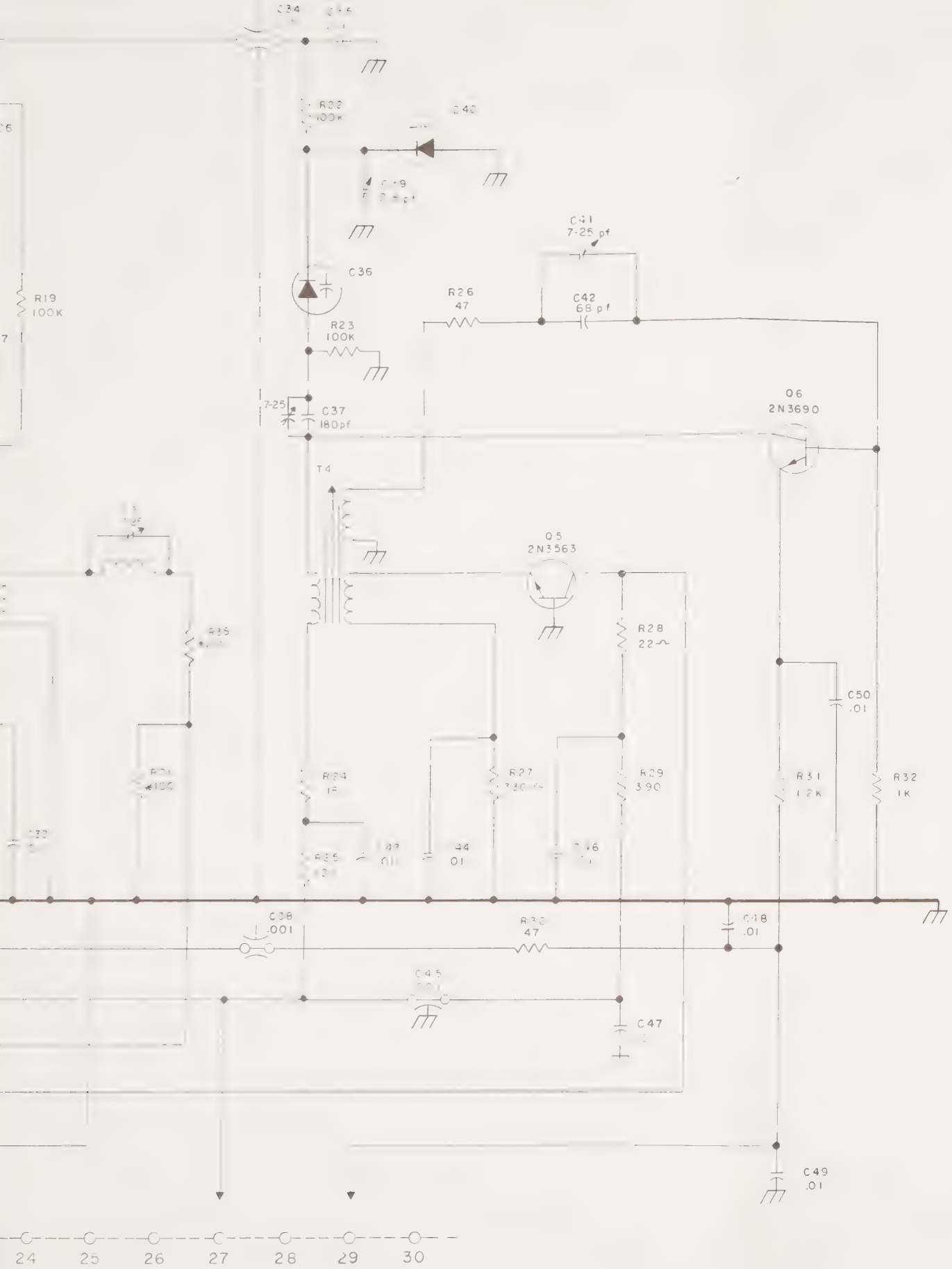


NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A2A1-10, COMPLE PART NUMBER IS A2A1(R5).

Figure 6.6 Band 10 (A2A1-10), Schematic Diagram

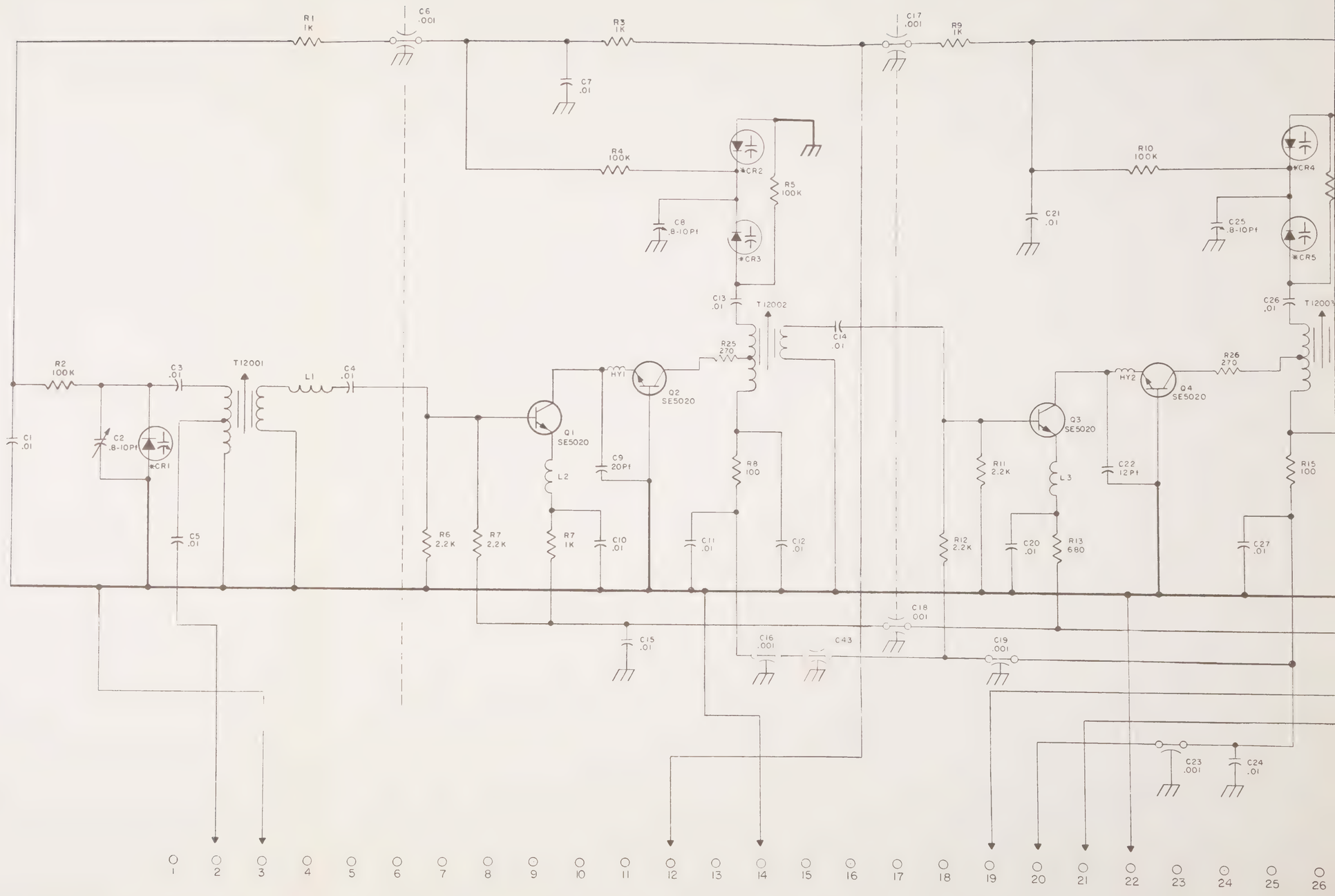

R2 1K
C6 .001
C17 .001
R17 1K
R3 100K
C7 .01
C11 8-10 pf
R9 100K
R10 1K
R15 100K
R1 100K
C3 01
T1
C47 .01
C4
C2 8-10
C5 .01
Q1 2N918
R6 47
C8 12 pf
Q2 2N918
R8 4.7K
R33 270
T2
C16 .01
Q3 2N918
Q4
R34 270
R4 2.2K
R5 2.2K
R7 3.9K
R11 100
R12 2.2K
R13
R18 10
R16 1.8K
C14 .01
C13 .01
C15 .01
C19 .01
C20 001
R14 2.7
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

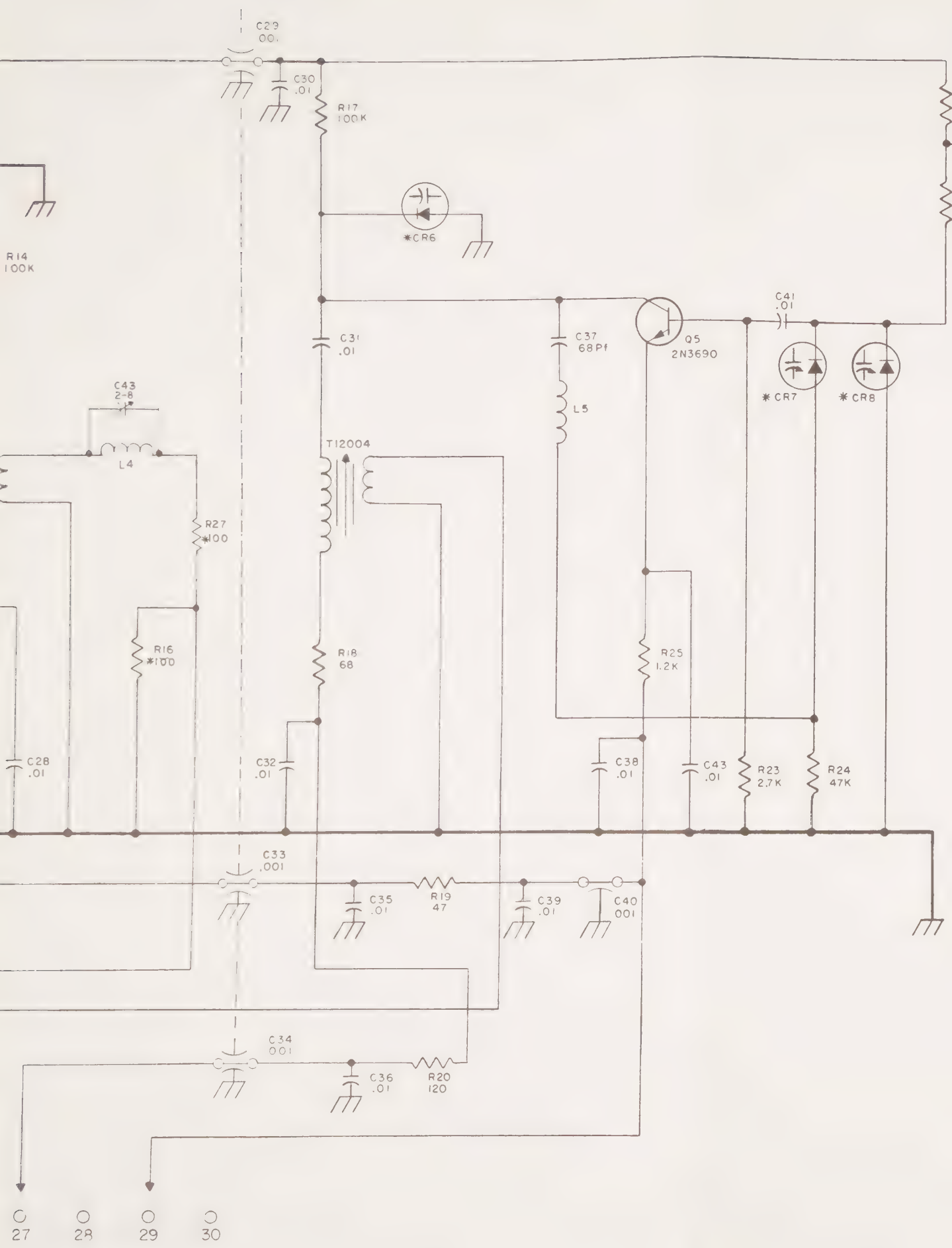


NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY, EXAMPLE : R5 ON ASSY A1P2 COMPLETE PART NUMBER IS A1P2(R5)

Figure 6.7 Band 11 (A2A1-11), Schematic Diagram


R1 1K
C6 .001
R3 1K
C17 .001
R9 1K
C7 .01
R4 100K
*CR2
R5 100K
C8 .8-10Pf
*CR3
R10 100K
*CR4
C21 .01
C25 .8-10Pf
*CR5
C13 .01
T12002
C26 .01
T12003
R25 270
C14 .01
R26 270
R2 100K
C3 .01
T12001
L1
C4 .01
HY1
Q2 SE5020
HY2
Q4 SE5020
Q1 SE5020
Q3 SE5020
C1 .01
C2 .8-10Pf
*CR1
C9 20Pf
R8 100
R11 2.2K
L3
C22 12Pf
R15 100
L2
C5 .01
R6 2.2K
R7 2.2K
R7 1K
C10 .01
C11 .01
C12 .01
R12 2.2K
C20 .01
R13 680
C27 .01
C18 001
C15 .01
C16 .001
C43
C19 .001
C23 .001
C24 .01
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

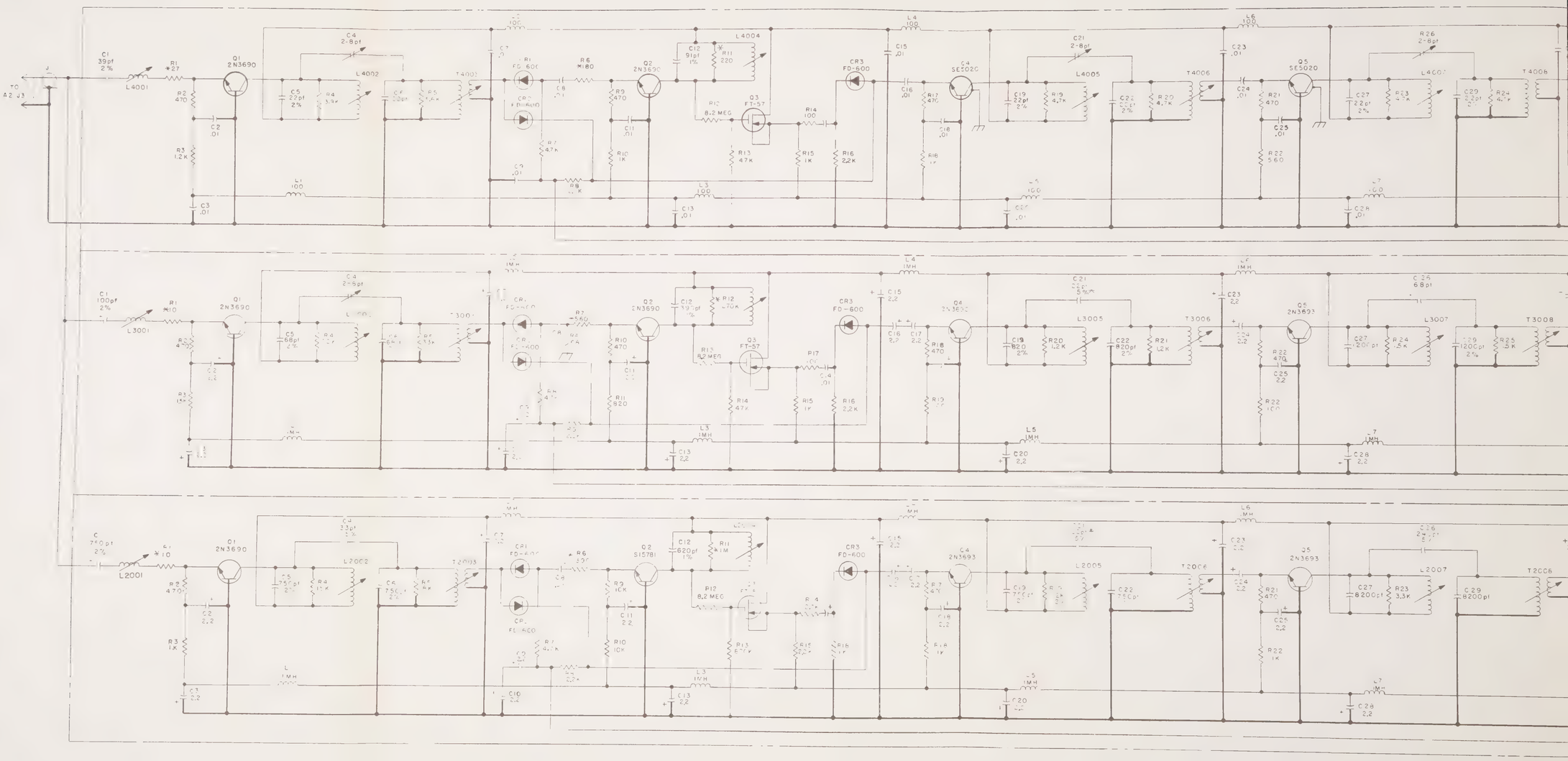


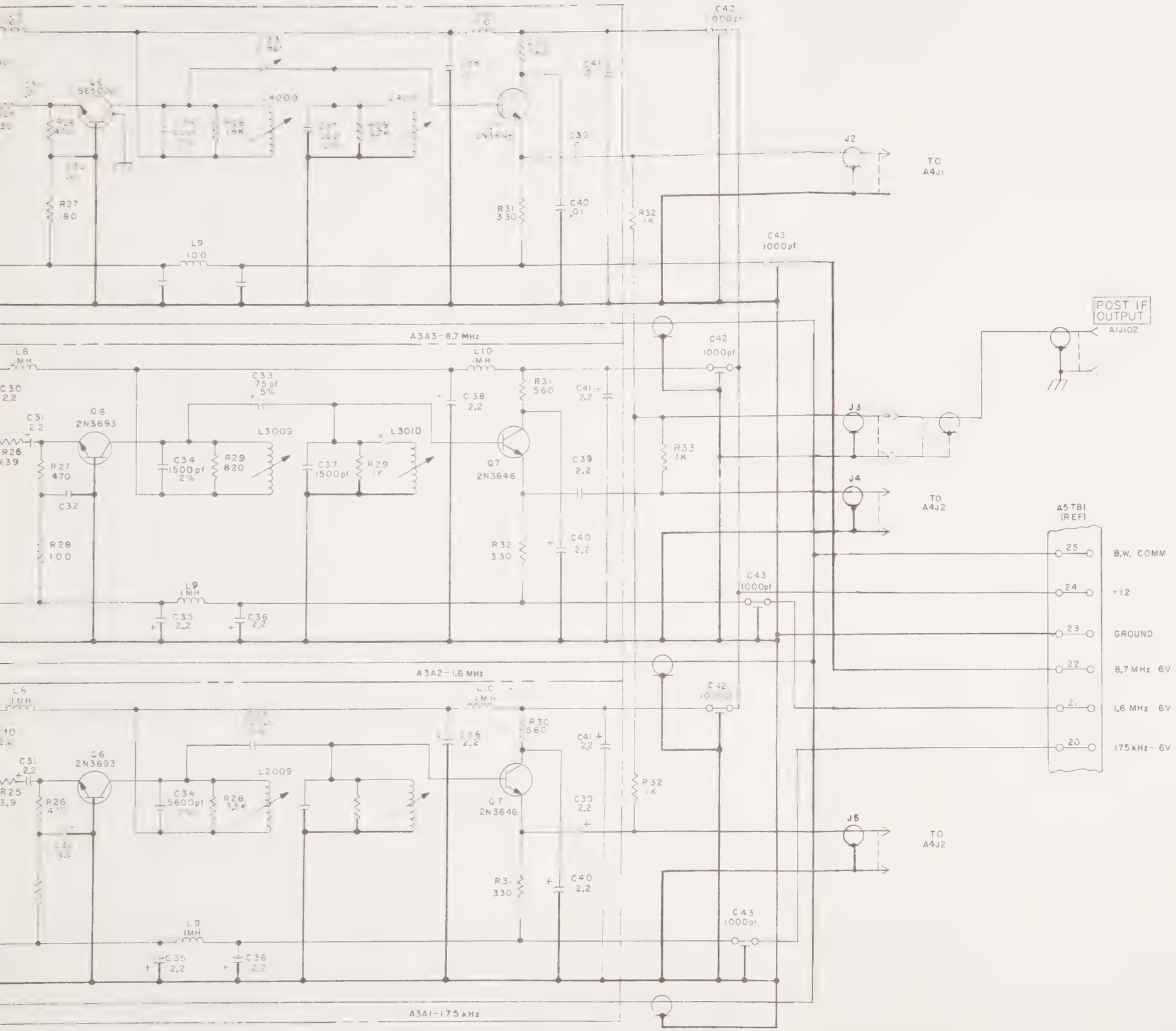
NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER, USE PREFIX AS AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A1P2, COMPLETE PART NUMBER IS A1P2 (R3).

Figure 6.8 Band 12 (A2A1-12), Schematic Diagram

Figure 6.9 Bands 13, 14, and 15 (A2A1-13, 14, 15), Schematic Diagram





NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ± 10%
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED × ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R30 ON ASSY A3A2, COMPLETE PART NUMBER IS A3A2 (R30).

Figure 6.10 IF Amplifier (A3), Schematic Diagram

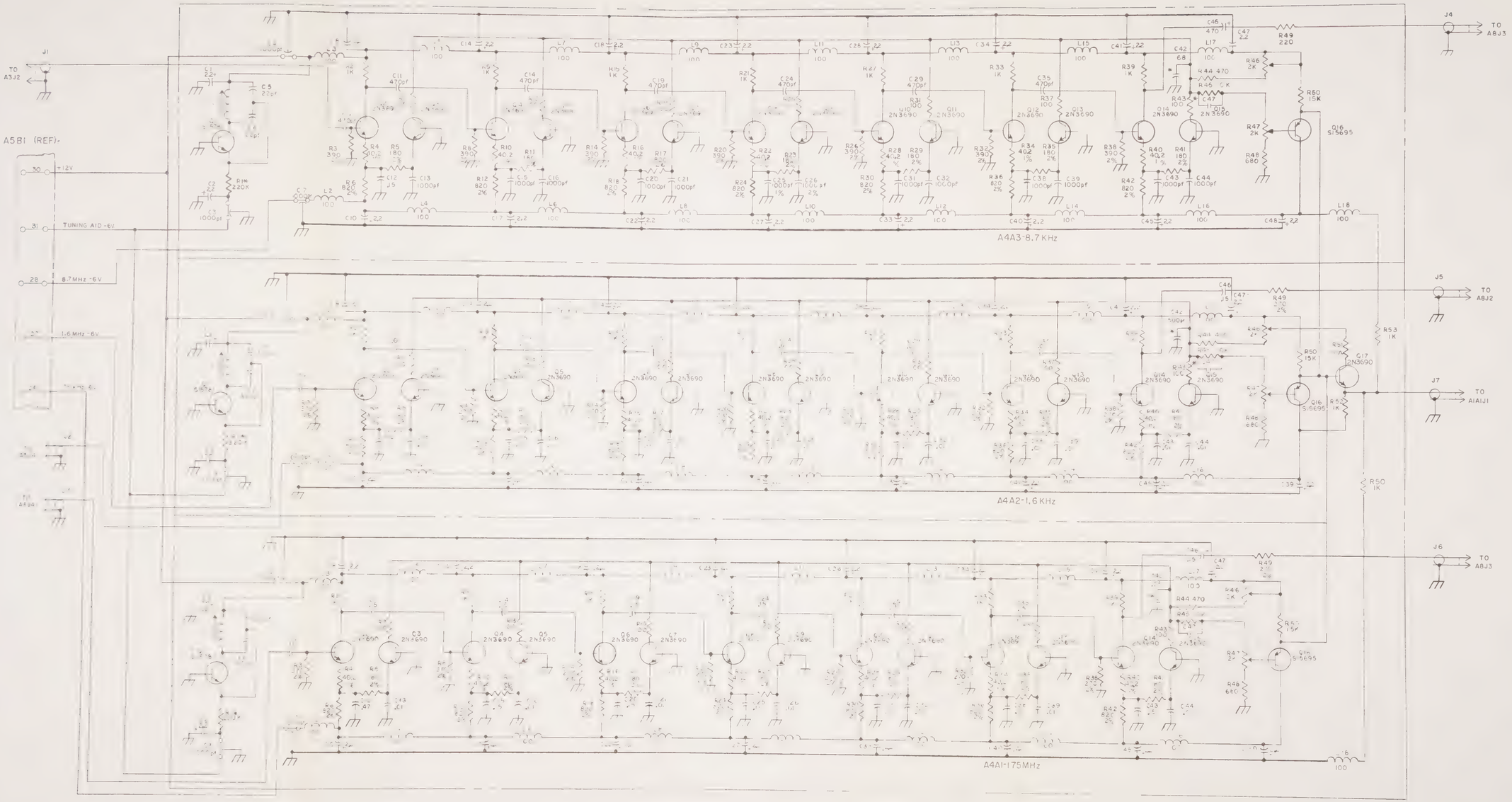

A5B1 (REF)
30 +12V
31 TUNING AID -6V
28 8.7MHz -6V
1.6MHz -6V
TO A3J2
TO A4J4
J1
A4A3-8.7KHz
A4A2-1.6KHz
A4A1-175MHz
J4 TO A8J3
J5 TO A8J2
J7 TO A1A1J1
J6 TO A8J3
NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A4, COMPLETE PART NUMBER IS A4 (R5).

Figure 6.11 Log Detector (A4), Schematic Diagram

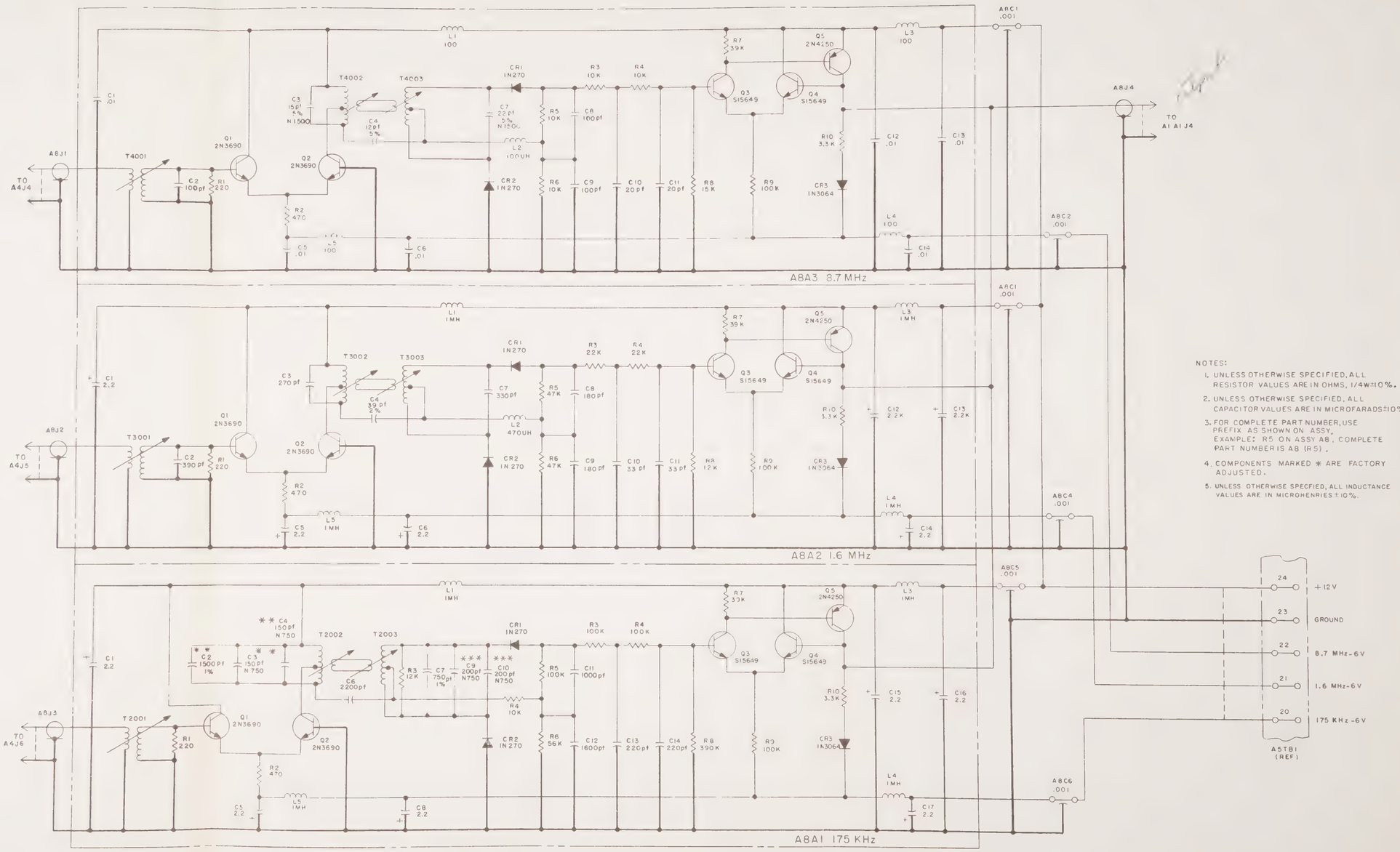
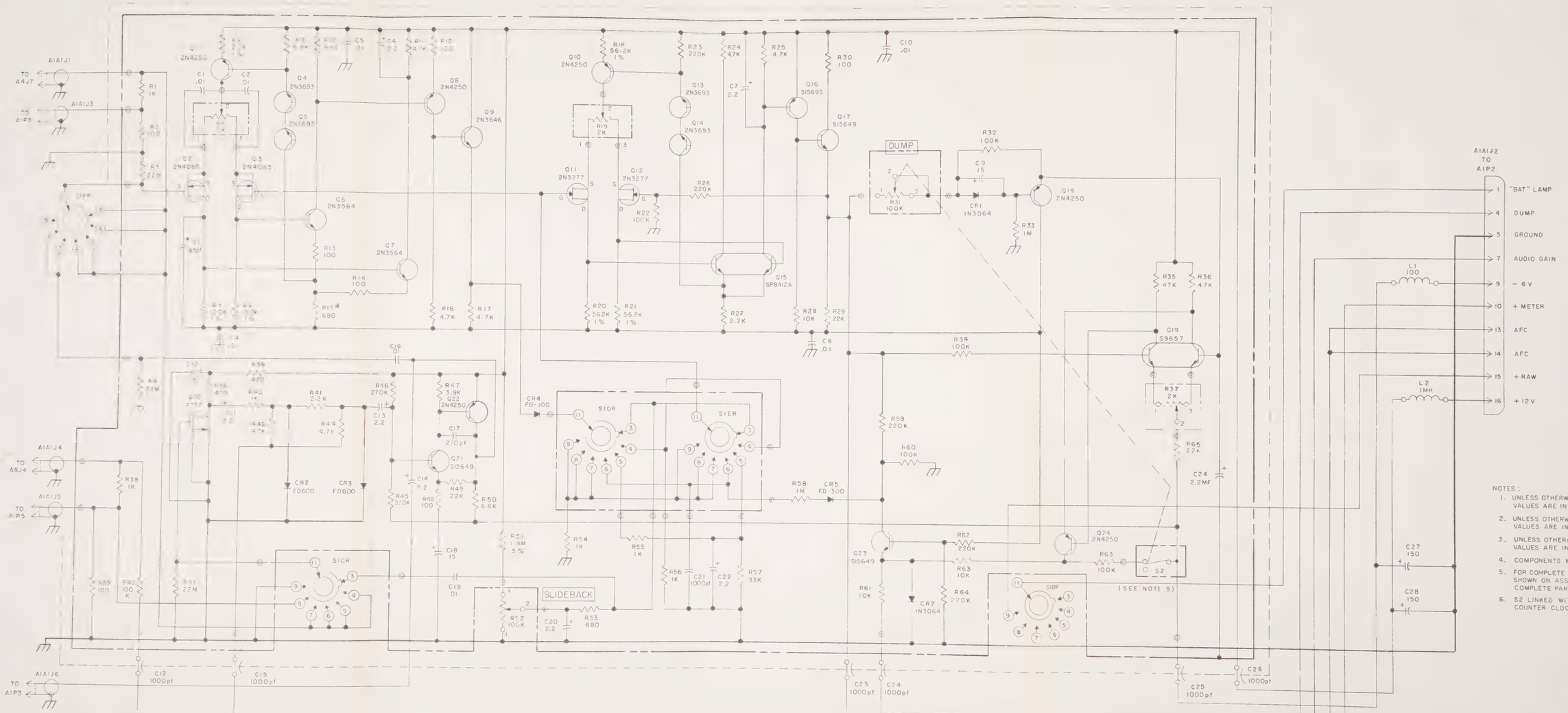


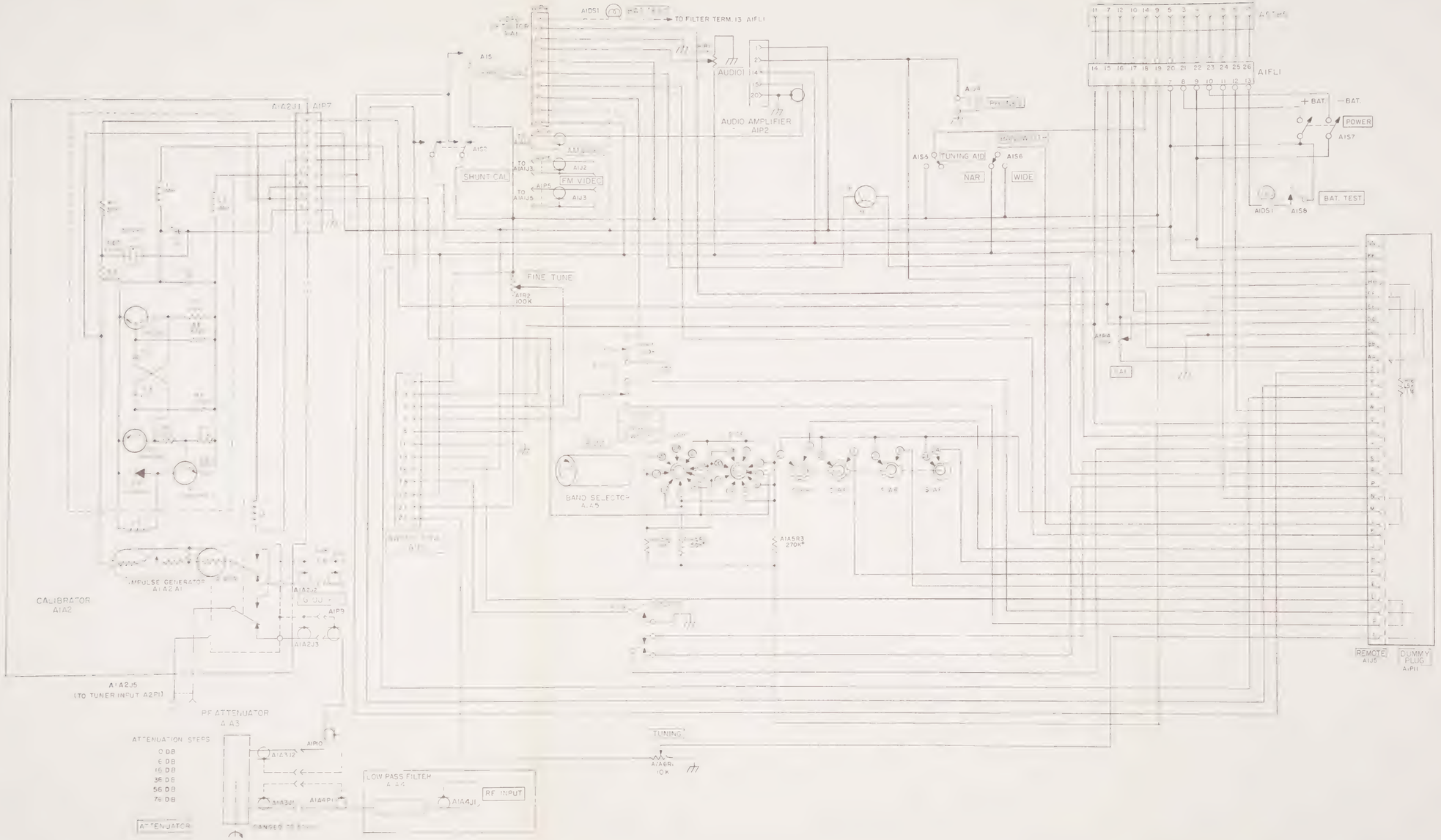
Figure 6.12 Discriminator (A8), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED.
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R5 ON ASSY A1A1 COMPLETE PART NUMBER IS A1A1 (R5).
6. S2 LINKED WITH R31 IS OPEN IN THE FULLY COUNTER CLOCKWISE POSITION.

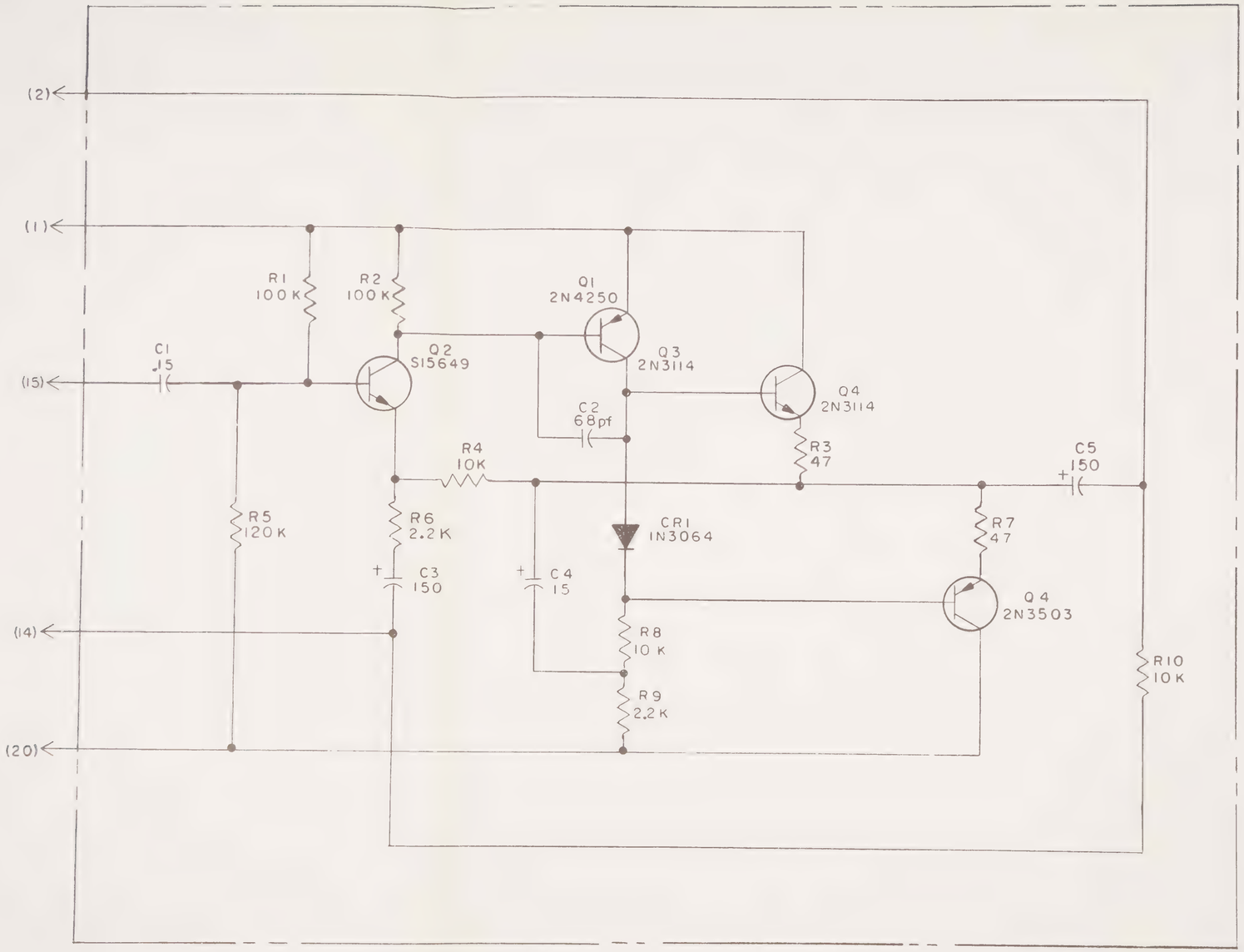
Figure 6.13 Video Detector (A1A1), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4, ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. COMPONENTS MARKED x ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. ALL SWITCHES ARE SHOWN IN BAND ONE POSITION.
6. FOR COMPLETE PART NUMER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R15 ON ASSY A1A2, COMPLETE PART NUMBER IS A1A2(15).

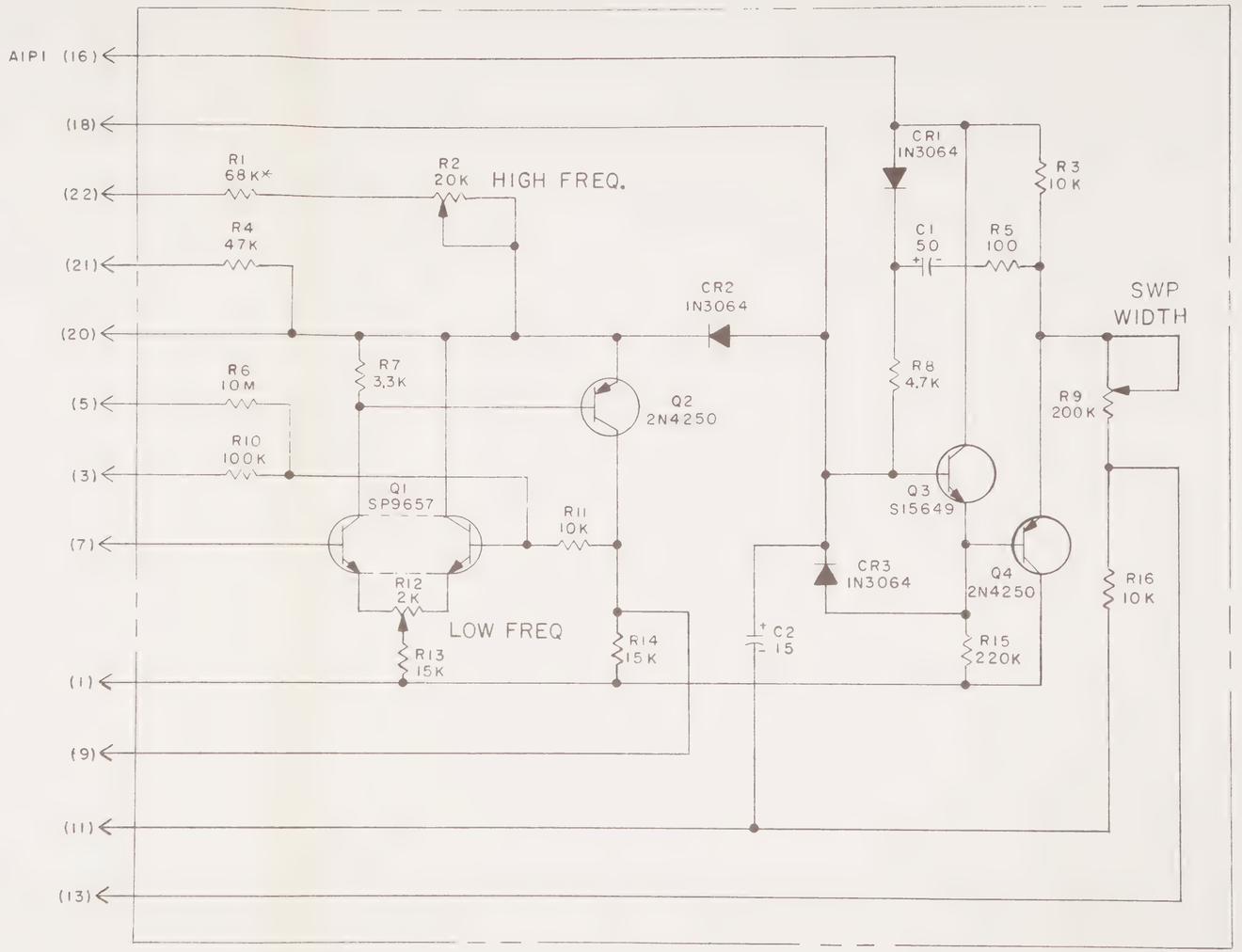
Figure 6.14 Control Section (A1A6), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A1P2, COMPLETE PART NUMBER IS A1P2 (R5).

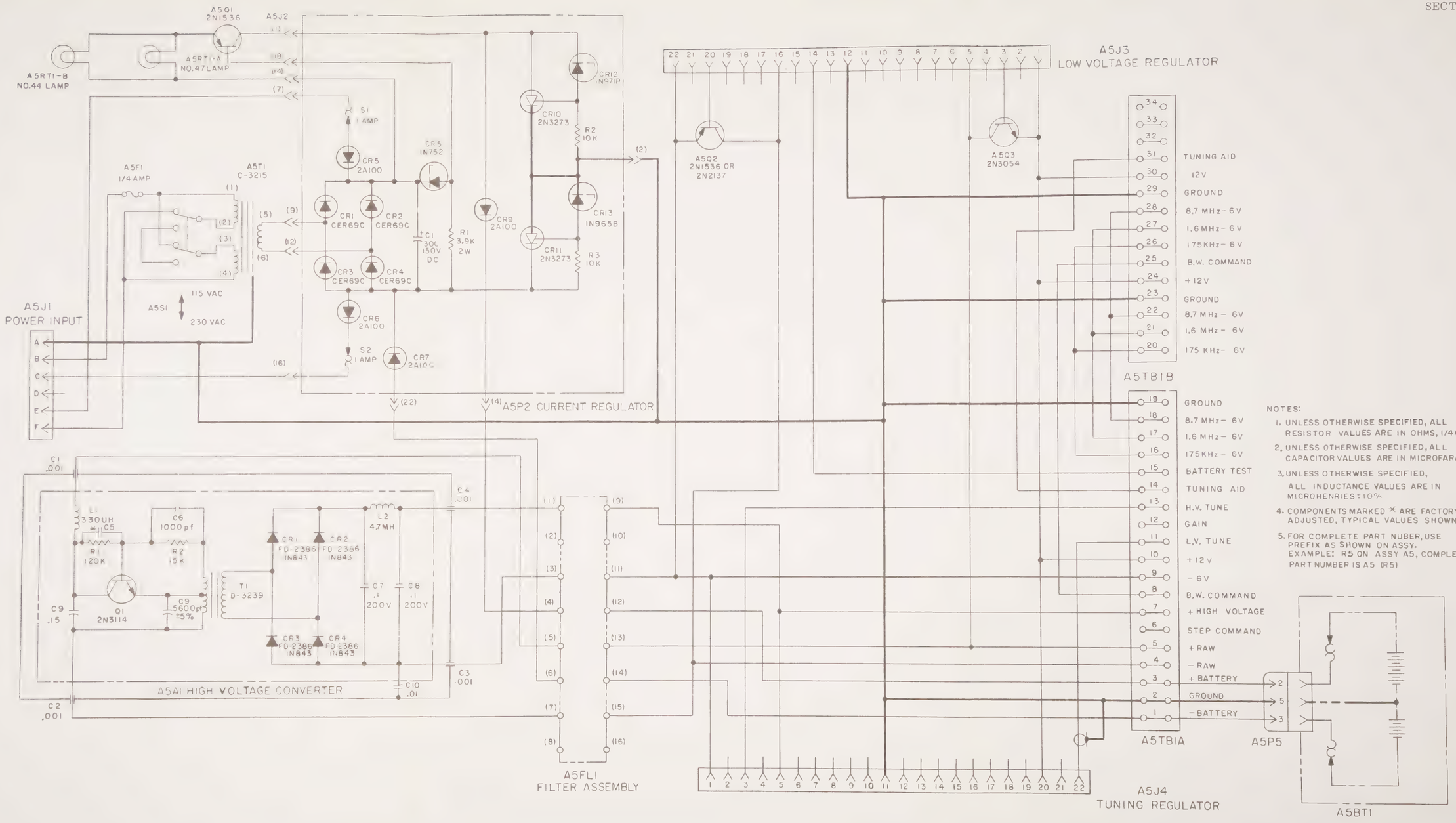
Figure 6.15 Audio Circuit (A1P2), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. UNLESS OTHERWISE SPECFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A1P1, COMPLETE PART NUMBER IS A1P1 (R5).

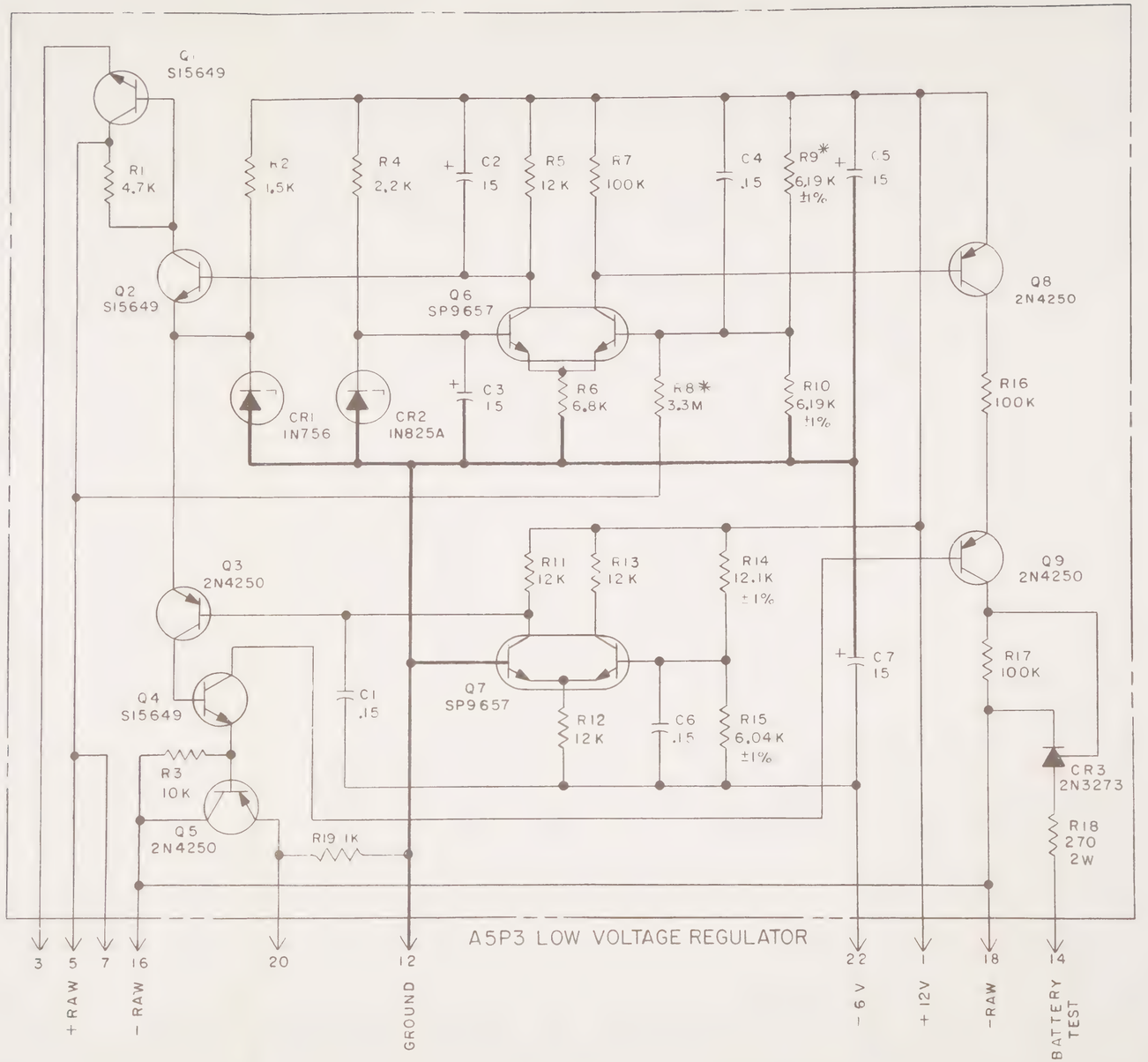
Figure 6.16 Sweep Circuit (A1P1), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ±20%
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUBER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A5, COMPLETE PART NUMBER IS A5 (R5)

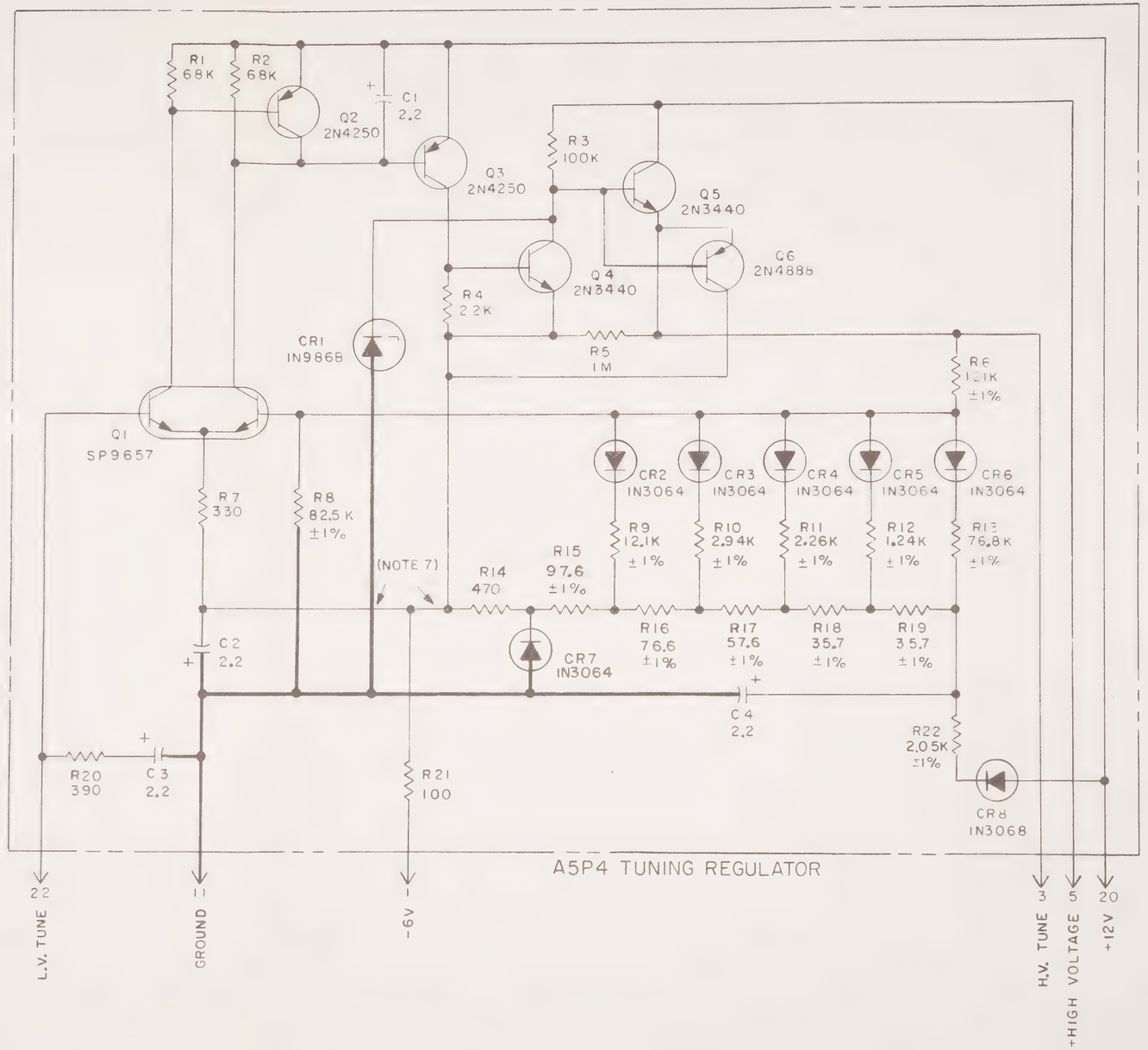
Figure 6.17 Power Supply (A5), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ± 10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS ±10%.
3. UNLESS OTHERWISE SPECIFIED ALL INDUCTANCE VALUES ARE IN MICROHENRIES ±10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER, USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R5 ON ASSY A5P3, COMPLETE PART NUMBER IS A5P3 (R5).

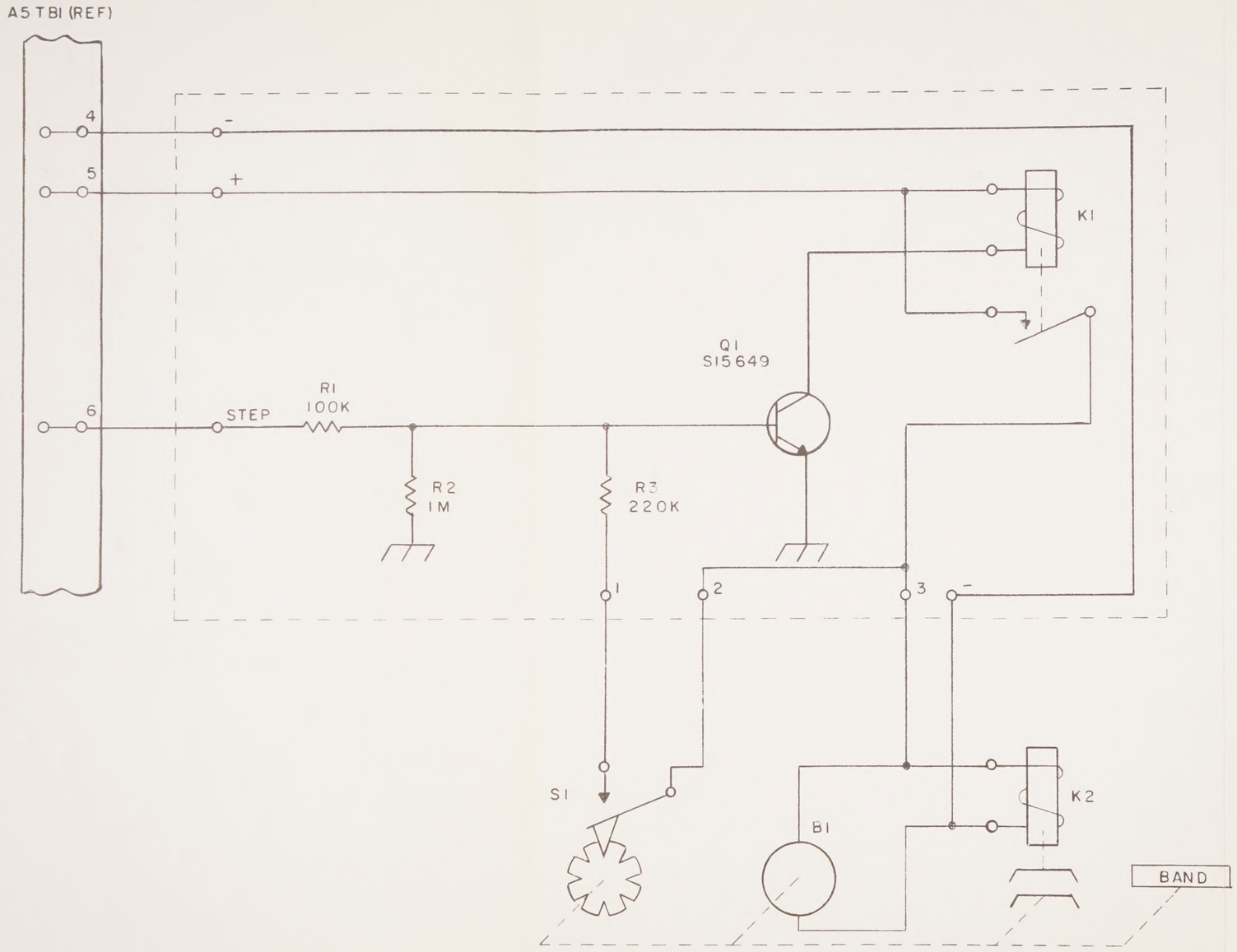
Figure 6.18 Low Voltage Regulator (A5P3), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/4W ±10%.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITOR VALUES ARE IN MICROFARADS 10%.
3. UNLESS OTHERWISE SPECIFIED, ALL INDUCTANCE VALUES ARE IN MICROHENRIES ± 10%.
4. COMPONENTS MARKED * ARE FACTORY ADJUSTED, TYPICAL VALUES SHOWN.
5. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE: R 5 ON ASSY A5P4, COMPLETE PART NUMBER IS A5P4 (R5).
6. Q6 IS NOT INSTALLED ON ALL ASSEMBLIES.
7. CR1 (IN986B) IS SELECTIVELY CONNECTED AS SHOWN OR TO THE JUCTION OF R21 AND R14.

Figure 6.19 Tuning Regulator (A5P4), Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECFIED , ALL RESISTOR VALUES ARE IN OHMS 1 4W ±10%.
2. FOR COMPLETE PART NUMBER USE PREFIX AS SHOWN ON ASSY. EXAMPLE R1 ON ASSY A9 COMPLETE PART NUMBER IS A9(R1).

Figure 6.20 R Option (A9), Schematic Diagram

Warranty

Electro-Metrics Corporation warrants that the articles delivered under each purchase order or contract will be free from defects in material or workmanship, under normal use and service, for a period of one year from the date of delivery to the Buyer. Electro-Metrics' obligations under this paragraph are limited, at its option, to repairing or replacing with reasonable promptness, such articles which are returned to Electro-Metrics' factory at Amsterdam, New York, transportation charges prepaid, and which, after examination are disclosed to Electro-Metrics' satisfaction to be thus defective. Semiconductors, electron tubes, fuses and batteries are excluded from liability. The provisions of this paragraph are effective only if a claim is made in writing to Electro-Metrics with the relevant information with respect to the alleged defect, within thirty (30) days following discovery of said defect.

The foregoing provisions of this warranty shall be effective only if the articles delivered under this purchase order or contract have been maintained, repaired, handled, utilized and stored in accordance with Electro-Metrics written instructions relating thereto and have not been subjected to misuse, improper installation, negligence, or accident. The provisions of this Warranty Clause are in lieu of all other warranties, expressed or implied, and of all other obligations or liabilities on Electro-Metrics' part and it neither assumes nor authorizes any other person to assume for Electro-Metrics any other liabilities in connection with the sale of the said articles. In no event shall Electro-Metrics be liable for any consequential or special damages.

Vice President, General Mgr.

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Buyer_____

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